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(54) Ink jet cartridge, ink jet apparatus and ink container.

(57) An ink container connectable with an ink inlet portion of an ink jet head having a plurality of ink ejection outlets, comprising an improvement in which a surface of the ink container to be connected with the ink jet head is inclined from a plane perpendicular to a detection in which the ink container is connected with the ink supply portion.

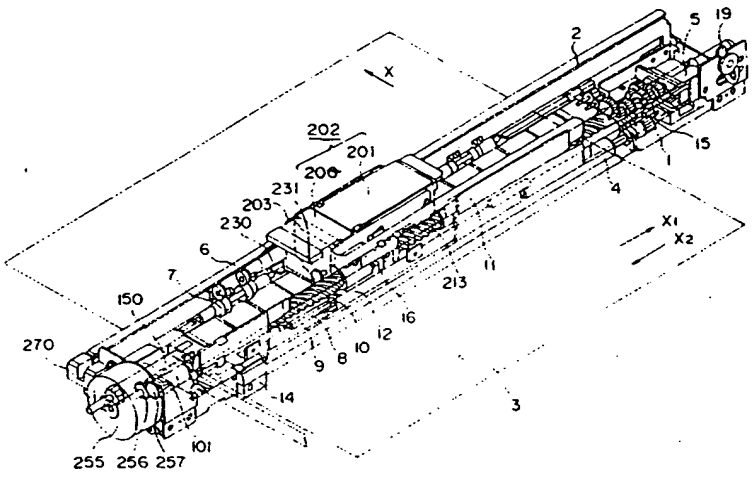

FIG. 1

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FIELD OF THE INVENTION AND RELATED ART

The present invention relates to an ink jet cartridge, an ink jet apparatus and an ink container, more particularly to an ink jet head detachably mountable on an ink jet apparatus and detachably mountable relative to an ink container, a small size ink jet cartridge using the same, and an ink jet apparatus usable with the ink jet cartridge.

Recently, various types of recording systems have been developed. Among them, an ink jet recording system in which ink is ejected through an ejection outlet in accordance with a recording signal, is widely used because the size reduction and the noise reduction are easily accomplished.

The ink jet recording apparatus are classified into a serial type recording system in which a recording head provided with a plurality of nozzles is mounted on a carriage, and the ink is ejected through the nozzles while the carriage is moved in a direction substantially perpendicular to the recording sheet feeding direction, and a line type recording system in which a recording head having a plurality of nozzles arranged in a direction substantially perpendicular to the recording sheet feeding direction, and the ink is ejected through the nozzles while the recording sheet is being fed. Because of the recent demand for the small size apparatus, the serial type apparatus is widely used. As for the driving method in these recording systems, it is avoided that the ink is ejected simultaneously through a plurality of nozzles because of the necessity for supplying the consumed amount of the ink to the recording head and in order to avoid the supply of large electric current to the recording head as a result of the simultaneous driving of the nozzles. More particularly, the ejection timing is deviated for each nozzles, or the nozzles are grouped into a plurality of blocks, and the driving timing is deviated for the respective blocks. However, in the above-described serial type recording system, the carriage carrying the ink jet head is moved, or the recording sheet is fed, while the ink is ejected through the nozzles, and therefore, when the block driving system is used, the deviation of the ejection timing appears as the deviation of the record positions.

In the prior art, when the driving signals are applied to the nozzles #1 - #m at the timing shown in Figure 26, (b), the respective nozzles are arranged such that the nozzle array is inclined by d = V x tm, where tm is the amount of deviation in the ejection timing, and V = R/t cycle is a feeding speed of the carriage. By doing so, the deviation (d in Figure 26, (a)) in the above-described recording operation, is corrected to accomplish the recording shown in Figure 27.

Figures 28, (a), and (b), are schematic views of an example of an ink jet cartridge as seen from the nozzle, on the carriage when the nozzle array is inclined by a predetermined angle from a direction perpendicular to the scanning direction (X1, X2).

In Figure 28, (a), an ink jet cartridge in the form of a recording head 200 having an array of ejection outlets 5, and an ink container 201 combined therewith, is carried on a carriage 203. In this Figure, the scanning direction of the carriage 203 (X1, X2) is a longitudinal direction of the carriage 201. However, the ink jet cartridge on the carriage 203 is inclined relative to the scanning direction of the carriage 203, as shown in the Figure, by which the array of the ejection outlets (nozzle array) is inclined by a predetermined degree.

On the other hand, in Figure 28, (b), the position of the ink jet cartridge on the carriage 203 is the same as the longitudinal direction of the carriage, but the longitudinal direction of the carriage 203 is different from the carriage scanning direction, by which the ejection outlet array is inclined by a predetermined amount. In Figures 28, (a), (b), Xa designates a direction in which the recording head and the ink container are separated or combined. Figure 28, (c), shows this inclination of the nozzle array of the recording head shown in Figure 28, (a), (b), as seen from behind the recording head. The direction of the nozzle array is inclined by θ from a perpendicular direction relative to the carriage moving direction X1, X2, and the mounting and demounting direction Xa between the recording head and the ink container, is inclined by θ.

If the mounting and demounting direction between the recording head and the ink container, is inclined by θ relative to the carriage movement direction, the lateral expansion of the recording head and the ink container in the direction of the carriage movement, is increased by $L\sin\theta$, where L is the total length of the recording head and the ink container.

For example, when L = 60 mm, and θ = 1 degree, the increase is approx. 1 mm. Accordingly, the above-described arranged gives rise to the difficulty in reducing the size of the carriage and/or the size of the recording apparatus. In a recent small size ink jet apparatus, an ink jet cartridge in which the ink jet head and the ink container are separable from each other to permit replacement of the ink container in consideration of the larger length of the service life of the ink jet head. In such a system in which the ink jet head and the ink container are separable, an additional space is required to permit the junction or separation between the ink jet head and the ink container, in the apparatus. Therefore, the shown system involves the difficulty in reducing the size of the apparatus.

On the other hand, as a method of connecting a replaceable ink container to an ink jet recording head, there is a method in which an ink container plugged with elastic member such as rubber member, is pierced with a needle integral with a pipe to establish an ink passage to the ink jet recording head. In this case, the ink is contained in a bladder made of polymer or the like in the ink container. However, this method involves a drawback that a required volume is large because of the length of the needle and the existence of the plug of the ink container, and therefore, it is not suitable in view of the recent demand for the size reduction.

With the tendency of the small size apparatus, the apparatus is more frequently carried around, and in view of the fact, the stabilized retention of the ink in the container in the apparatus is highly desired. So, a high polymer porous absorbing material is preferably used as an ink accommodating material, in the container. However, in this case, it becomes difficult to supply the ink to the recording head using the above-described needle.

The reason is as follows. A gap in communication with the external ambience is formed around the needle with the result that the air is sucked through the gap despite the amount of the ink remaining in the absorbing material is sufficient. This may lead to failure of the ink jet apparatus. In order to avoid this problem, as shown in the Figure, a method will be considered in which the porous material containing the ink is press-contacted to the porous absorbing material containing the ink. However, in this case, it becomes difficult to supply the ink to the recording head using the needle. This is because a gap communicating with external ambience is formed around the needle so that the air is sucked through the gap despite a sufficient amount of the ink remains in the absorbing material. If this occurs, the printing operation becomes not possible, as the case may be.

It would be considered in order to avoid this problem that an ink inlet portion 20 of the recording head is press-contacted to the porous absorbing material containing the ink. In this case, the hermetical sealing to the prevent introduction of the air into the ink passage through the connecting portion between the recording head and the ink container, is required. In order to provide a solution to this problem, it would be required that an O-ring 206 is provided on the circumferential periphery of the connecting pipe to provide the hermetical sealing between the recording head and the ink container. In this system, the O-ring is already mounted on the recording head in the plant, and therefore, when a user connects the ink container to a new recording head, the air may be introduced between the recording head and the ink container, or on the contrary, the ink is leaked out.

The causes for this, have been investigated, and it has been found that upon the connection of the ink container, the O-ring does not smoothly slide on the ink inlet portion of the recording head by the connecting surface of the ink container with the result of deformation of the O-ring. When this occurs, the gap is produced between the connecting surface of the ink container and the connecting surface of the recording head. This trouble does not always occurs, and the frequency is not so high. However, the frequency is increased depending on the variation of the dimension of the recording head and the variation in the dimension of the O-ring. If the elastic member constituting O-ring is kept being stressed, it may stick to the ink supply portion of the recording head, so that the above-described problem is increased. In such a case, even if the ink container is moved in the mounting or demounting direction, the O-ring does not slides easily with the result of twisting, even to such an extent that the O-ring is damaged or torn.

Therefore, when the ink container is connected for the first time after the manufacturing, it is desirable that the force is applied in a direction perpendicular to the sliding surface with the O-ring, that is, in the direction away from the sliding surface. On the other hand, in the case of the recording head with which the ink containers have been replaced a number of times, the ink connecting portion is wetted with the ink in many cases. Therefore, the friction between the O-ring and the ink supply portion, is very small, so that hardly any trouble occurs.

However, when the ink container is to be taken out, the O-ring may be slightly raised from the connecting surface of the recording head because of the small friction. If the apparatus is left with this state, the ink may be dried, and the similar problem arises when a new ink container is connected.

SUMMARY OF THE INVENTION

Accordingly, it is a principal object of the present invention to provide an ink container, an ink jet head and an ink jet cartridge using the same in which when the nozzle array is inclined by a predetermined degree, the operativity is satisfactory, and the size is small.

It is another object of the present invention to provide an ink container, ink jet head and an ink jet cartridge of an ink container detachable type, in which the ink container and the ink jet head are securedly connected, and it is effectively avoided that the air is introduced into the ink passage through the connecting portion and that the ink leaks out through the ink passage.

According to an aspect of the present invention, the mounting and demounting direction of the

ink container is in accord with the carriage feeding direction even if a direction in which the plurality of ejection outlets are arranged is inclined relative to the mounting and demounting direction between the ink jet head and the ink container. By doing so, even if the nozzle array is inclined from the perpendicular direction relative to the carriage feeding direction, the width in the direction perpendicular to the carriage feeding direction when the recording head and the ink container are connected with each other, can be minimized, and therefore, the size of the ink jet recording apparatus can be reduced.

The surface of the recording head and the surface of the ink container at the connecting portion between them, are inclined relative to a plain perpendicular to the mounting and demounting direction between the recording head and the ink container. By doing so, even if the ink container is connected for the fist time after the manufacturing of the apparatus, a part of the O-ring is first urged to the inclined connecting surface of the ink container, thus permitting smooth motion.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic perspective view of an ink jet recording apparatus according to an embodiment of the present invention.

Figure 2 is a schematic perspective view of a carriage used in the ink jet recording apparatus shown in Figure 1.

Figure 3 is an enlarged schematic perspective view of the carriage according to the embodiment of the present invention.

Figure 4 is a schematic perspective view illustrating the connection between the carriage and the head cartridge in the ink jet recording apparatus according to the embodiment.

Figure 5 is a schematic view illustrating the positioning method between the carriage and the head cartridge in an ink jet recording apparatus according to the embodiment.

Figure 6 is a schematic view illustrating the mounting and demounting directions among the carriage, the recording head and the ink container in the ink jet recording apparatus according to the embodiment of the present invention.

Figure 7 is a schematic view illustrating the mounting and demounting directions among the carriage, the recording head and the ink container in an ink jet recording apparatus according to an embodiment of the present invention.

Figure 8 is a timing chart of ink ejection of the recording head of the first embodiment of the present invention.

Figure 9 shows a result of record by an ink jet recording apparatus according to the first embodiment of the present invention.

Figure 10 illustrates the mounting and demounting directions among the carriage, the recording head and the ink container in an ink jet recording apparatus according to an embodiment of the present invention.

Figure 11 illustrates a relation between an O-ring and an ink container in an embodiment of the present invention.

Figure 12 shows an ink container according to an embodiment of the present invention.

Figures 13, 14, 15, 16 and 17 show ink containers according to other embodiments of the present invention.

Figure 18 illustrates an ink container using a sealing device with the sliding surface.

Figure 19 illustrates the sealing function.

Figures 20 and 21 show ink containers according to other embodiments of the present invention.

Figure 22 is a perspective view illustrating the advantageous effects of the present invention.

Figure 23 schematically shows the container usable with an ink jet cartridge according to an embodiment of the present invention.

Figure 24 is a schematic perspective view of an information processing apparatus comprising the ink jet recording apparatus according to the first embodiment of the present invention.

Figure 25 is a block diagram of an electric circuit of the information processing apparatus including the ink jet recording apparatus according to the first embodiment.

Figure 26 is a timing chart illustrating the nozzle arrangement and the ejection timing of a recording head according to background art.

Figure 27 shows result of recording in the background art.

Figure 28 is a schematic view illustrating the mounting and demounting direction among the carriage, the recording head and the ink container of the background art ink jet recording apparatus.

Figure 29 illustrates an ink jet cartridge according to background art.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the accompanying drawings, the embodiments of the present invention will be described in detail.

First, the description will be made as to an ink jet apparatus using an ink jet cartridge in which the

ink container and the ink jet head are integral.

Referring to the accompanying drawings, the embodiments of the present invention will be described in detail.

Referring to Figure 1, there is shown a recording apparatus according to an embodiment of the present invention, in the perspective view. In the figure, a reference numeral 203 designates a carriage for carrying thereon a recording head cartridge 202 having a recording head 200 constituting the recording means and an ink container 202 integral with recording head 200. An end of the carriage 203 adjacent the recording head 200 is engaged with a lead screw 213 for sliding movement in the axial direction, the lead screw 13 being rotatably mounted in a frame 1. The carriage 203 is provided with a guide at another end, and the guide is engaged with a guide rail 2 in the frame 1 for sliding movement in the direction parallel to the axis of the lead crew 213. The carriage 203 is reciprocable in the axial direction with rotation of the lead crew 13, while the pose thereof is maintained constant.

As shown in the figure, a lead screw gear 257 fixed to the left end of the screw and a pinion gear 256 fixed to an output shaft of the carriage motor 255, are in meshing engagement, and a lead screw pin 209 mounted to the carriage 203 is engaged in a guide groove 268 helically formed at a predetermined pitch on the lead screw 213. Therefore, when the lead screw 213 rotates by the forward or backward rotation of the carriage motor 255, the carriage 203 reciprocates. The detail of the scanning operation of the carriage 203 will be described in detail hereinafter.

A flexible cable transmits the printing signal to the recording head 200 from electric circuit which will be described hereinafter. It is supported on a pinch roller frame 11 at a predetermined position by a flexible cable holder 16.

The recording head 203 is moved in synchronism with the reciprocal movement of the carriage 203, and the ink is ejected in accordance with the recording signal, thus effecting recording on the recording material 3 in one line. The recording head 200 comprises fine liquid ejection outlets (orifice), liquid passages, energy application portions in the parts of the liquid passages, and energy generating means for generating energy for formation of liquid droplet.

As for the energy generating means, there are electromechanical transducer element such as a piezoelectric element, electromagnetic wave such as laser to produce heat to eject the liquid, and electrothermal transducer element in the form of a heat generating resistor or the like to heat the liquid to eject it.

Among them, in a recording head of ink jet recording type in which the liquid is ejected using thermal energy, the liquid ejection outlets for formation of the droplets of the liquid can be arranged at high density, and therefore, a high resolution recording is possible. Particularly, the recording head using the electrothermal transducer element as the energy generating means, can be easily reduced in the size. In addition, the advantages of IC manufacturing techniques and micro-machining techniques which are recently significantly developed and which are recently reliable, can be used, and therefore, high density arrangement is possible with the advantage of low manufacturing cost.

When one line recording is completed by the scan of the carriage 203, the recording material 3 is fed by one line by feeding means, and the next line recording operation is carried out. The feeding of the recording material 3 is accomplished by a pair of feeding roller 4 and a pinch roller 8 press-contacted thereto, and a pair of discharging roller 7 and spurs 6 contacted thereto.

More particularly, the recording material 3 having a recording surface faced to the ejection side surface of the recording head 200 is press-contacted to the feeding roller 4 by the pinch roller 8, and the feeding roller 4 is rotated by a sheet feed motor 5, by which the recording material 3 is fed through a proper distance. After the recording operation, the recording material is press-contacted to the discharging roller 7 by the spurs 6, and the recording material is discharged to the outside of the apparatus by the rotation of the discharging roller 7.

The feeding roller 4 and the discharging roller 7 are driven by the feeding motor 5 through a reduction gear train 15.

A paper sensor 14 functions to detect presence or absence of the recording material 3. A reference numeral 270 designates a home position sensor, which detects whether the carrier 203 is back at the home position (left side in the figure) before the recording is started.

Designated by a reference numeral 270 is a home position sensor which detects the resetting of the carriage 203 at the home position (left side in Figure), before the start of the recording operation.

Figure 2 is a perspective view of the head cartridge and the carriage of the recording apparatus according to this embodiment of the present invention. In this figure, reference numeral 200 designates a recording head for ejecting the ink in accordance with electric signal; 201, an ink container for containing the ink to be supplied to the recording head; 203, a carriage in the main assembly of the apparatus effective to carry the recording head 200 and the ink container 201; 204, a head lever for supporting and releasing the recording

head; 205, an ink container lever for detachably mounting the ink container 201; 207, a head holder spring for fixing the recording head 200 to the carriage 203; 208, a container case for supporting the ink container 201. By these elements, the head cartridge and the carriage are constituted.

The recording head 200 comprises a base plate having a plurality of electrothermal transducer elements for producing thermal energy used for ink ejection and driving circuit for driving them, a top plate for forming ejection outlets and liquid passages corresponding to the respective electrothermal transducer elements and for forming a common liquid chamber communicating with the liquid passage, and electric contacts for supplying electric signals from the main assembly to the driving circuit. The recording head 200 may be provided with sensors for permitting the main assembly of the recording apparatus to detect the states of the recording head. More particularly, the sensors include a temperature sensor for detecting the temperature of the recording head in the neighborhood of the electrothermal transducer elements, ink sensor for detecting a remaining amount of the ink in common liquid chamber, and head identification sensor for identification of types of the head cartridge when different types of heads are exchangeably usable. The signals from the sensors are discriminated by the main assembly of the recording apparatus, and the signals applied to the electrothermal transducer elements are controlled, accordingly, thus providing the optimum printing conditions.

The ejection side surface having the ejection outlets of the recording head is faced to the recording material in the recording apparatus.

The description will be made as to the mechanical and electrical connection between the recording head 200 and carriage 203.

Figure 3 is a sectional view taken along a line a in Figure 2, illustrating the connection between the carriage 203 and recording head 200. Figure 4 is a perspective view illustrating the process. In the Figures, reference numeral 225 designates positioning pins engageable with corresponding holes of a recording head on the carriage 203 to accurately position the recording head 200 in a direction a and a direction b in Figure 4; 226 designates a stopper fixed on the carriage 203 to stop the recording head 200 urged in the direction a in Figure 3; 211 is a flexible cable for electrically connecting the recording head 200 and the main assembly of the recording apparatus; 211a, a positioning hole in the flexible cable 211; 211b, a positioning hole in the flexible cable 211; and 212, a flexible cable pad elastically supporting the flexible cable 211 and sandwiched between the flexible cable 211 and the carriage 203. In addition, reference numeral 212a designates a positioning hole in the flexible cable pad 212; 212b, a positioning hole in the flexible cable pad 212; 212c, an ink barrier for preventing ink entrance to the contact position; 222, a head contact portion electrically connected with the heater in the recording head 200; 227a, a positioning hole in the head contact 227; 227b, a positioning hole in the head contact portion 227; and 227c, a stopper abutment for abutting with the end surface of the stopper 226.

The recording head 200 is urged in the direction a through an unshown lever by the head holder spring 207. The position thereof is definitely determined by the engagement between the hole of the recording head 200 and the positioning pin 225 and by the interference with the stopper 226. In this manner, the recording head 200 and the carriage 203 are mechanically connected.

On the end surfaces of the head contact portion 227 of the recording head 200 and the flexible cable 211, there are provided corresponding plural electric contacts. They are pressed to each other with a predetermined pressure, so that the main assembly of the recording apparatus and the recording head 200 are electrically connected. It is necessary that the respective contacts are pressed at once. For the purpose of uniform pressing, there is provided a flexible cable pad 212 of elastic material. The material of the flexible cable pad 212 is of silicone rubber. It comprises plural projections at positions corresponding to the electric contacts to concentrate the pressure on the contact points. The electric contacts of the flexible cable 211 may be in the form of projection sin order to further assure the pressure concentrated on the contact points.

Since the reaction force produced upon the pressing is designed to be far smaller than the force of the head holder spring 207 for urging the recording head 200, and therefore, the recording head 200 is prevented from deviation by the reaction force from the flexible cable pad 212.

The carriage 203, the flexible cable pads 212, the flexible cable 211, the head contact portion 227 and the head cartridge 203 are required to be correctly positioned relative to each other in order to assure the electric connection and the high print quality. In order to accomplish this, the following structure is used.

One of the positioning point 225 commonly engages with the positioning hole 212a, the positioning hole 211a and positioning hole 227a, and the other positioning pins 225 commonly engages with the positioning hole 212b, the positioning hole 227b, by which the positioning in the directions a and b in Figure 4 are accomplished.

In this embodiment, stoppers 226 are provided, being inclined by relative to the directions X1 and

X2 in which the carrier 203 is moved. As for the nozzles #1 - #m of the recording head 200, they are aligned with a predetermined pitch of P and also, in such a manner so that the nozzle alignment line is inclined to give the nozzle #m a deviation of d relative to the nozzle alignment length of H. Further, in order to assure precisely the predetermined amount of d, a distance G between the stoppers 226 is established to be larger relative to the nozzle alignment length.

The description will be made as to an ink jet head, an ink container and an ink jet cartridge according to an embodiment of the present invention.

Figure 6 is a schematic view of the ink jet head 200 and the ink container 201, as seen from the ink ejection side, illustrating the connecting relation between them. Figure 6, (a) shows a state in which the recording head 200 and the ink container 201 are mounted on the carriage 203 movable in directions X1 and X2. The recording head and the ink container are on the way of connection.

In Figure 6, in order to incline the ejection outlets #1 - #m, from a direction perpendicular to the carriage movement directions X1 and X2, the recording head 200 per se is inclined in accordance with the positioning portion 225 of the carriage. In this embodiment, even if the recording head is inclined, the ink inlet portion 220 is in accord with the carriage movement direction (longitudinal direction of the carriage in this embodiment) so that the direction of connection with the ink container is substantially in accord with the movement direction of the carriage. The connecting surface 221 with the ink container is inclined so that it is perpendicular to the carriage movement direction (the longitudinal direction of the carriage).

The junction or connection surface 221 of the recording head relative to the ink container, is not necessarily in contact with each other, and is inclined relative to the ejection outlet array. The ink supply portion 220 is inclined from a direction perpendicular to the array of the ejection outlets.

Figure 6, (b) is a plan view illustrating the inclined relation in various directions, as seen from the front side of the recording sheet. The ink container mounting direction Xa is substantially parallel with the carriage movement direction X1 and X2 during the printing operation. The direction of the nozzle array is inclined by angle θ from a direction perpendicular to the ink container mounting (demounting) direction Xa.

In Figure 6, (c), the ink container 201 has been connected with the recording head 200.

By disposing the connecting surface 221 inclinedly relative to the array of the ejection outlets, the array can be inclined from the carriage movement direction by a predetermined degree, without size increase of the carriage or the ink jet apparatus or without the influence to the operativity in the engagement or disengagement between the head and the ink container. Therefore, the size reduction of the apparatus and the correct recording can be accomplished, simultaneously.

Figure 7 shows another embodiment of the present invention. As shown in Figure 7, (a), the connecting plane between the recording head 200 and the ink container 201 is not perpendicular to the mounting or demounting direction Xa. It may be along the nozzle array direction (it is not necessarily completely parallel, if the advantageous effects of the present invention are provided). As described in the foregoing, the same advantageous effects can be provided when the connecting surface of the ink container rather than that of the recording head is inclined.

In the foregoing embodiment, ink inlet portion, is provided on the recording head 200, but it (projection) may be provided in the ink container 201 side, as shown in Figure 7, (b).

In the foregoing, the description has been made as to a recording head for monochromatic recording. However, the advantageous effects of the invention, are more significant when a plurality of recording heads and ink containers for different colors, are used.

The description will be made as to the recording method and the inclination of the ejection outlet array, using an ink jet cartridge comprising an ink jet head and an integral ink container.

Referring to Figure 8, there is shown the timing of ink ejection of the recording head.

In Figure 8, the recording head 200 ejects the ink to accomplish the record shown in Figure 9, while the carriage 203 is moved in the direction X1 (Figures 1 and 5).

The ink is ejected in the order from nozzle #1 to nozzle #m. Ejection time difference between nozzle #1 and #2 is designated by t1; the difference of times of ejections between nozzle #1 and nozzle #m, is indicated by tm - 1; and the period of ejections of one nozzle is indicated by tcycle. Usually, the time difference between the adjacent nozzle ejections, is preferably constant. Therefore, tm - 1 = (m-1) x t1. The ink ejecting operations are carried out at tm - 1 = d x tcycle/R, while the carriage 203 is moved in the direction X1 at a speed R/tcycle. By doing so, the time difference tm - 1 of the ink ejection through the nozzles and the inclination d of the nozzle array (Figure 5) are combined to provide the record without the deviation (inclination), as shown in Figure 9. When the recording operation is carried out while the carriage 203 is moved in the direction X2, the order of ejections are reversed, that is, from #m to #1.

The degree of the nozzle inclination d is preferably tm - 1 = tcycle/2 - tcycle, from the standpoint of the uniform energy application to the recording head and the ink supply. Therefore, d = R/2 - R is preferable. Usually, pitch P of the nozzle is equal to R. In this case, the degree of inclination d is preferably P/2 - P.

In the foregoing, the description has been made as to the structure in which the ejection outlet array is inclined without increasing the size of the carriage or without deterioration of the operativity. In an embodiment shown in Figure 7, (a), the following problems can be solved.

Figure 10, (a) shows the state in which the connection between the recording head and the ink container of an ink jet cartridge according to this embodiment, mounted on the carriage, is not completed. It is a view as seen from the ejection outlet side. In this embodiment, in order to increase the sealing between the ink container and the ink jet head, a sealing member (O-ring) 222 in the form of a ring is provided at an ink supply portion of the ink jet head.

The connecting surface of the ink container 201 with the recording head is inclined from a direction perpendicular to the connecting direction between the ink jet head and the ink container.

Figure 10, (b) shows a relationship between the head cartridge portion and the carriage after the ink container 201 is mounted. In this Figure, the O-ring 222 shown in Figure 10, (a), is not seen, because it is behind the recording head and the ink container. In Figure 11, (a), the connection is illustrated between the recording head and the ink container shown in Figure 10. In this Figure, the ink container 201 is on the way of connection relative to the recording head 200, more particularly, at the instance when the connecting surface of the ink container starts to contact the left part of the O-ring 222. In this embodiment, the connecting surface of the ink container is inclined from a direction perpendicular to the connecting direction, relative to the ink inlet portion 220. Therefore, a part of the connecting surface is first brought into contact with a part of the O-ring 222, and applies force thereto.

When the contact portion of the O-ring is first urged by this force, an inside of the O-ring, that is, such a part of the recording head as is contacted to the ink supply portion 222, and the neighborhood thereof, are slightly apart from the contact surface, so that the friction between the O-ring and the surface of the ink inlet portion, is abruptly reduced to permit smooth sliding motion. Particularly when the ink container is first connected with the recording head, all parts are dried, and the elastic member (silicone rubber) constituting the O-ring, is attracted to the ink inlet portion, and therefore, the force effective to urge the O-ring away from the contact surface, is significantly advantageous, even if the force is small. In the case of a recording head with which the ink containers have been exchanged a large number of times, the portion is wetted with the ink in many cases, and therefore, the friction force between the O-ring and the projected side surface, is extremely small. For this reason, hardly any problem arises. However, when the ink container is dismounted, the O-ring may be away from the contact surface of the recording head because of the small friction force, in some cases. If the O-ring is left in this state for a long period of time, the ink is dried, and when the ink container is connected again, the problem described above may arise. For this reason, the advantageous effects provided by moving a part of the O-ring by the connecting surface of the ink container, at first, is significant.

In the case of Figure 11, (a), the force tending to separate the O-ring from the sliding surface of the ink supply portion of the recording head (lateral surface) is applied only at the left portion. At the right hand portion, the urging force toward the sliding surface rather than the separating force is applied because of the tension from the left portion. Therefore, it seams that the sliding motion is easy at the left, but it is difficult at the right hand portion. Actually however, once the left side part is separated from the first sliding surface, the motion of the O-ring as an entirety thereof becomes easy. The reason for this is considered as follows. Figure 11, (b) illustrates this. A part (left part) of the O-ring 222 mounted to the ink inlet portion 220 is deformed by the force applied by the connecting surface of the ink container. In this Figure, the O-ring partly separated from the original position is still stacked on the ink inlet portion 220 at the right hand portion beyond a boundary P. However, the left half has already been separated from the ink supply portion. Therefore, the force produced by being urged to the connecting surface of the ink container, is concentrated only on the point P as a tension F1 along the O-ring. Therefore, the O-ring is easily removed by the component force F2 at the point P. As a result, the boundary P moves to the right. This continuously occurs, and therefore, the O-ring is completely becomes slidable on the ink inlet portion 220, thus permitting the movement thereof to be closely contacted to the connecting surface of the recording head. The inclination angle relative to the surface perpendicular to the ink container mounting and demounting direction, is advantageous when it is about 1 degree, but may be larger. However, if it is too large, the volume efficiency of the ink container is deteriorated.

Figure 12 shows an ink container according to an embodiment of the present invention. For the sake of simplicity of explanation, the inside struc-

ture is omitted in the Figure. In the Figure, (a) is a lateral sectional view of the ink container, (b) is a sectional plan view, and (c) is a view as seen from the connecting surface.

The ink container comprises two members, namely, a cover 205 and a main body 201. The connecting surface is indicated by a reference numeral 199. A hole 183 receives a projection of a recording head into the ink container. A reference numeral 184 designates a claw for engagement with a recording head portion. A sealing portion 185 functions as a sealing portion when the ink supply ports 186 and 202 are connected by ultrasonic fusing or the like. In this example, the cover is connected with the main body with inclination to provide an inclination angle at the connecting surface. The height of the sealing portion 185 is different along the surface of the cover.

Figure 13 shows an ink container according to another embodiment. In Figure 12, the thickness of the cover is constant. In this embodiment, however, the thickness of the cover 205 is changed to provide the inclination angle at the connecting surface 199. In this embodiment, the height of the sealing portion 185 is constant along the circumference.

Figure 14 shows an ink container according to a further embodiment. Similarly to the case of Figure 12, but a recess 188 is formed around the hole 189, and therefore, the connecting surface 199 is provided by the bottom of the recess.

Figure 15 shows another example of the ink container, in which only the engaging hole 189 of the connecting surface of the ink container is inclined. In this structure, the difficulty of motion of the O-ring can be avoided even in the ink container of Figure 6.

Figure 16 shows a modification of Figure 13 container. The cover in Figure 13 is integral with the main body of the ink container.

Figure 17 is a similar modification of Figure 15, in which the member having the inclined surface and the container main body are integral with each other.

Figure 18 shows motion of the O-ring in a further embodiment in which the function of the O-ring is different from described above. The sealing operation of the O-ring is accomplished by a surface 201 which is parallel with the ink demounting direction. The sliding surface 201c of the ink container of Figure 18 and the side surface 220 of the ink inlet portion of the recording head, are concerned with the sealing function. In this system, the sealing is maintained even if no large force is applied in the demounting direction, and therefore, the mechanism is advantageous over the foregoing embodiments.

Figure 19 shows the connecting portion in more detail. The sealing portion of the ink container and the sealing portion of the recording head, are indicated by C. In this example, the diameter of the sliding surface of the ink container is slightly smaller than the outer diameter of the O-ring. For this reason, the force perpendicular to the sliding surface is applied to accomplish the sealing function. In this embodiment, the inclination angle relative to a plane perpendicular to the ink container mounting and demounting direction is significant. Similarly to the foregoing, the O-ring sticks to the ink inlet portion of the recording head, after substantial time period elapses after the manufacturing. Therefore, upon the first connection between the ink container and the recording head, does not slide smoothly with the result of improper sealing function. Therefore, similarly to the foregoing embodiment, it is desirable to urge the O-ring at one side at the initial stage. This is accomplished, in this embodiment, by inclining the connecting surface of the recording head and the connecting surface of the ink container, are inclined with respect to a plane perpendicular to the mounting and demounting direction of the ink container, as shown in Figure 19. Because of the inclination angle, upon the connection with the ink container, a point Q which is an edge of the connecting surface of the ink container 201, is first contacted to the O-ring. Similarly to the foregoing embodiments, the O-ring starts to be urged at one side. Thus, the stuck O-ring becomes movable to accomplish the proper sealing function.

Figures 20 and 21 show the ink containers of this example. In these examples, the thickness of the cover of the ink container is different. Similarly to Figure 14, a recess for receiving O-ring is provided, but in order to provide large area of the sliding portion at the side of the recess, the depth of the recess is large.

In the foregoing descriptions, an O-ring has been used for the close contactness between the ink container and the recording head. However, the O-ring is not inevitable, but another member, for example a washer (flat disklike member of a rubber material which may be produced by punching), may be used. In that case, the present invention is advantageous for the same reasons.

The angle between the connecting surfaces of the ink container and the ink jet recording head, are preferably empirically 0.5 degree relative to a surface perpendicular to the ink container mounting and demounting direction. It is preferably large. However, if the angle is too large, a space not contributable to the ink container or recording head, is required with the result of lower volume efficiency, and therefore, it is not desirable for a small size printer. For example, in the case that the cross-sectional area of the ink container is 20 mm x 20 mm and the length thereof is approx. 40 mm, using foamed polyurethane material as the ink ab-

sorber, the limit of the angle is approx. 30 degrees. If the angle is too large, an inside wedged space provided by the inclination angle, can not receive the ink absorbing material sufficiently into the end of the wedge, and therefore, the volume not contributable to the ink absorption is produced. However, this depend on the flexibility of the absorbing material, and therefore, the above-described limit value is not strict.

In the foregoing descriptions, the sealing members are set in the projection of the recording head. Conversely, however, the projection may be formed on the ink container side, and the sealing member may be disposed around the circumference thereof the sealing member is urged by the connecting surface of the recording head without the deterioration of the advantageous effects of the present invention.

Figures 23, (a), (b) and (c), are perspective views of ink containers of an ink jet head cartridge with which the present invention is usable. The ink container shown in the Figure is an ink container capable of being mounted to a carriage of the recording apparatus in vertically opposite two directions. There are provided an ink supply port (not shown) connected with the ink container portion to supply the ink to the recording head, and an air vent (not shown) for communicating the inside of the ink container with the ambience. A claw 1002 functioning as a stopper when the ink container is removed from the recording apparatus, and a cut-away portion 1001 for engagement with a projection of the recording apparatus upon the mounting on the recording apparatus, are provided at corresponding two positions, corresponding to two vertical opposite positions of the ink container.

In Figure 23, (a), the cut-away portion described above is disposed inside from the ink container, and therefore, upon the mounting on the recording apparatus, the projection of the recording apparatus can be protected from the external condition.

Figure 23, (b), (c), there is no side wall of the ink container, and therefore, the above-described protection effect is not provided, but the manufacturing of the ink container is easy.

In the foregoing, the description has been made as to an ink jet head, an ink container and an ink jet cartridge comprises them, and an ink jet apparatus having the ink jet cartridge.

The description will be made as to the recording apparatus using one or more of the above-described embodiments.

Next, an apparatus employing a recording apparatus incorporating the aforementioned various elements will be described.

Figure 24 is a perspective view of an outer appearance of an information processing apparatus 604 incorporating the recording apparatus of this embodiment. In the Figure, a reference numeral 601 designates a printer described above; 602, a keyboard provided with character numerical, other character keys and command keys; 603, a display portion with a display; 606, a window for permitting exchange of the recording head 200 and/or the ink container 21 described hereinbefore; 607, an openable cover for covering the window 606 other than when they are exchanged. The window 606 has a size enough to permit manipulation of the head lever 204 and the container lever 205 upon the ink container 201 exchange. A reference numeral 608 designates an exchanging switch for exchange of the recording head 200 and/or the ink container 201. When the exchanging switch 608 is actuated, the carriage motor 402a is driven, so that the carriage 203 is moved from the home position or the recording region to the window 606 position. At this position, when the exchange of the recording head 200 or the ink container 201 is completed, a release switch 609 is actuated. Then, the carriage 203 is returned to the home position, and thereafter, the recovery unit 271 carries out the recovery operation including sucking or ejecting the ink and wiping the recording head. Subsequently, the state before the exchange switch 608 is actuated, is established. The recording material is supplied to the printer 601 through a sheet supply port 610. The keyboard 602 is openable in a direction a for setting the recording material 6.

Figure 25 is a block diagram of the electric circuit structure of the information processing apparatus. In this Figure, a reference numeral 501 is a controller for the main control operation; 502, a CPU in he form of a microcomputer, for example, for carrying out various processes; 503, a RAM including an area for developing text data or image data and a work area; 504, a ROM for storing fixed data such as the program for the sequential operations and font data; 505, a timer for producing executing cycle of the CPU 502 and producing necessary timing for the recording operation of the printer 401; 506, an interface for supplying the signals from the CPU 502 to the peripheral device.

In addition, a reference numeral 507 designates a controller for the printer 401; 508, is a recording head detector for detecting information on the recording head such as outputs of sensors for detecting presence or absence of the recording head 200, the types thereof and the temperature thereof and outputs of the sensor for detecting presence or absence of the ink in the ink container 201; 509, a line buffer for storing record data for the recording head 200; 510, a head driver for supplying the recording signal and the electric power to the recording head 200; 511a, 511b and 511c are motor drivers for supplying necessary

signals and electric power for operation of the carriage motor4 255, the sheet feeding motor 5 and automatic sheet feed motor 323; 512, sensor detectors for detecting outputs of sensors such as the home position sensor 270. the paper sensor 14, the sheet feed initial sensor 320a, the sheet feed switch sensor 320b or the like. Furthermore, a reference numeral 404 designates an external memory such as FDD, HDD, RAM card or the like; and 405 is an external interface for connection directly with another information processing apparatus or for connection directly with an internal bus to control the peripheral devices. Although not shown in the block diagram, there is a power source for supplying electric power to the above electric circuits. The power source may be in the form of a chargeable battery, a disposable dry battery or an AC source converter fixedly used with the main assembly of the information processing apparatus.

As described in the foregoing, according to the embodiments of the present invention, the carriage movement direction is in accord with the mounting or demounting direction of the ink container by inclining the connecting surface of the ink container or the recording head with respect to the mounting and demounting direction of the recording head and the ink container, even if the array of the nozzles in the recording head is inclined to prevent the recording position deviation. Furthermore, the projection area. in the carriage movement direction of the connected recording head and ink container, is minimized. Therefore, without the difficulty in the connection between the recording head and the container, the size of the ink jet recording apparatus can be reduced. In addition, the connecting direction between the ink container and the recording head, is inclined with respect to the direction of the array of the ejection outlets, and therefore, the correct recording position can be accomplished irrespective of the state of the mounting of the ink jet cartridge on the carriage. According to embodiments of the present invention, the connecting surfaces of the ink container and the recording head, are inclined with respect to a surface perpendicular to the ink container mounting and demounting direction. Therefore, particularly after the time elapses after the manufacturing, the O-ring is prevented from stacking on the sliding surface upon the connection of the ink container by the user. Therefore, the inconveniences of improper printing due to the ink disconnection or large amount of unusable ink remained.

Because of the inclination angle relative to a plane vertical to the mounting direction of the ink container, a force along the connecting surface is produced as a component force of the force applied in the mounting direction, upon the connection of the ink container. The force tends to produce relative deviation between the ink container and the ink jet recording head along the connecting surface. This force is eventually received by an engaging claw or the like. Therefore, it may be correctly position in the direction along the connecting surface, without the necessity for a particular fixing pin or force producing means not concerned with the mounting or demounting action. Therefore, an ink jet recording cartridge which is highly reliable even against the vibration or the like, can be provided.

The inclination angle is effective to prevent erroneous insertion of the ink container or the like. For example, an erroneous insertion preventing groove may be provided at a side opposite from the connecting surface, as shown in Figure 22. This groove remarkably reduces the inside volume of the ink container. By using the inclination angle of this invention, the erroneous insertion can be avoided without significantly reducing the usable volume of the ink container. It may be used for distinction of the color by using different inclination angles for the respective colors, in the recently demanded color printing machines.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

An ink container connectable with an ink inlet portion of an ink jet head having a plurality of ink ejection outlets, comprising an improvement in which a surface of the ink container to be connected with the ink jet head is inclined from a plane perpendicular to a detection in which the ink container is connected with the ink supply portion.

Claims

1. An ink container connectable with an ink inlet portion of an ink jet head having a plurality of ink ejection outlets, comprising an improvement in which a surface of said ink container to be connected with the ink jet head is inclined from a plane perpendicular to a detection in which said ink container is connected with the ink supply portion.

2. An ink container according to Claim 1, wherein said surface is inclined from the plane toward a direction in which the plurality of ejection outlets are arranged.

3. An ink jet head for ejecting ink, comprising:
an array of ejection outlets for ejecting ink;

an ink inlet portion for receiving the ink from an ink container detachably connectable with said ink jet head;

wherein a connecting surface adjacent said ink inlet is inclined relative to the array.

4. An ink jet head according to Claim 3, further comprising a sealing member at the ink inlet portion.

5. An ink jet head according to Claim 3, wherein said connecting surface is substantially perpendicular to the connecting direction.

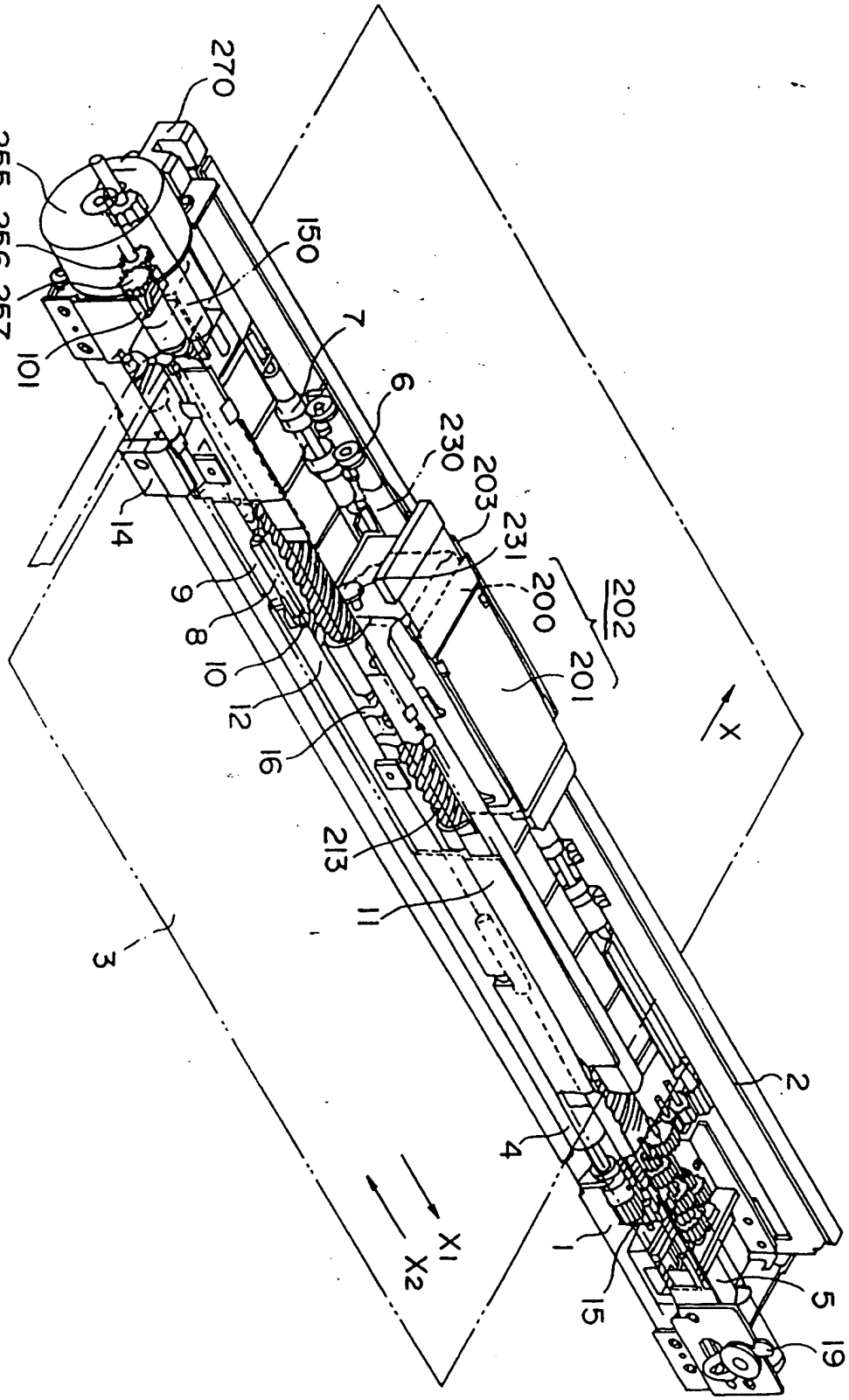
6. An ink jet head according to Claim 3, further comprising ink passages communicating with said ejection outlets, and ink ejecting pressure generating elements, corresponding to the ink passages.

7. An ink jet head according to Claim 6, wherein said ink ejection pressure generating elements are heat generating resistors.

8. An ink jet head cartridge for ejecting ink, comprising an ink container as defined in Claim 1 or 2, and an ink jet head having a plurality of ink ejection outlets for ejecting ink and an ink inlet portion for receiving ink by connection with said ink container.

9. An ink jet apparatus for ejecting ink to effect recording, comprising an ink jet cartridge as defined in Claim 8, and a carriage for detachably mounting said ink jet cartridge.

10. An ink jet apparatus for ejecting ink to effect recording, comprising an ink jet head as defined in any one of Claims 3 - 6, and a carriage for detachably mounting the ink jet head.


270
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256
257
150
101
7
6
230
203
231
200
202
201
14
9
8
10
12
16
213
11
3
X
X1
X2
2
4
1
15
5
19

FIG. 1

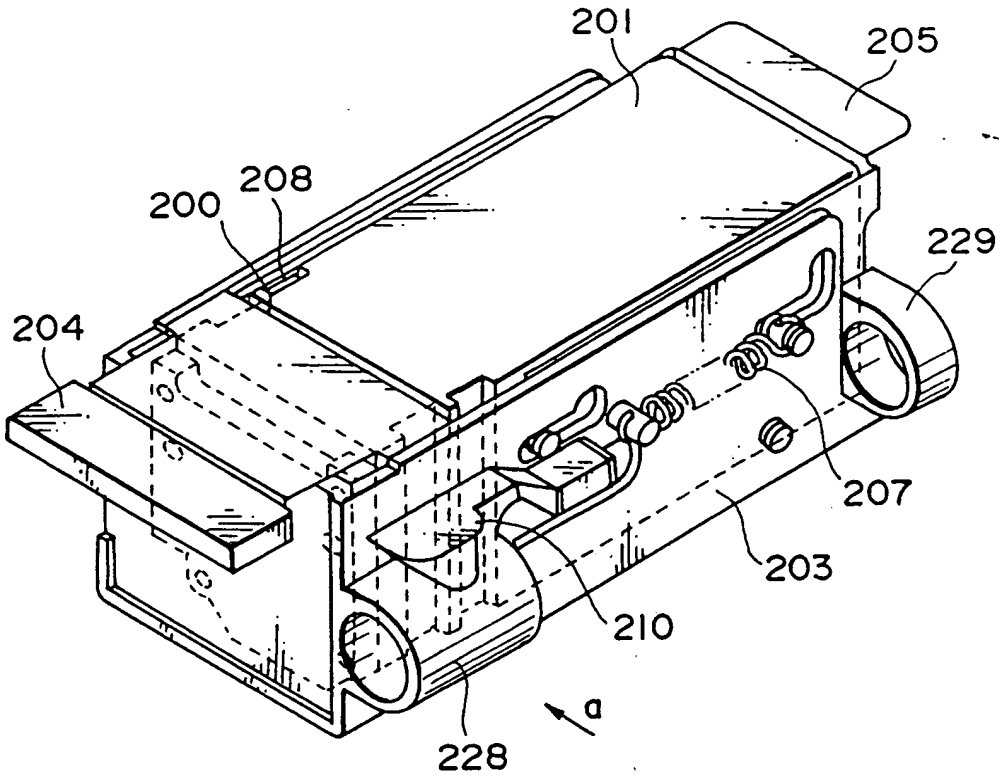

201
205
208
200
229
204
207
203
210
a
228

FIG. 2

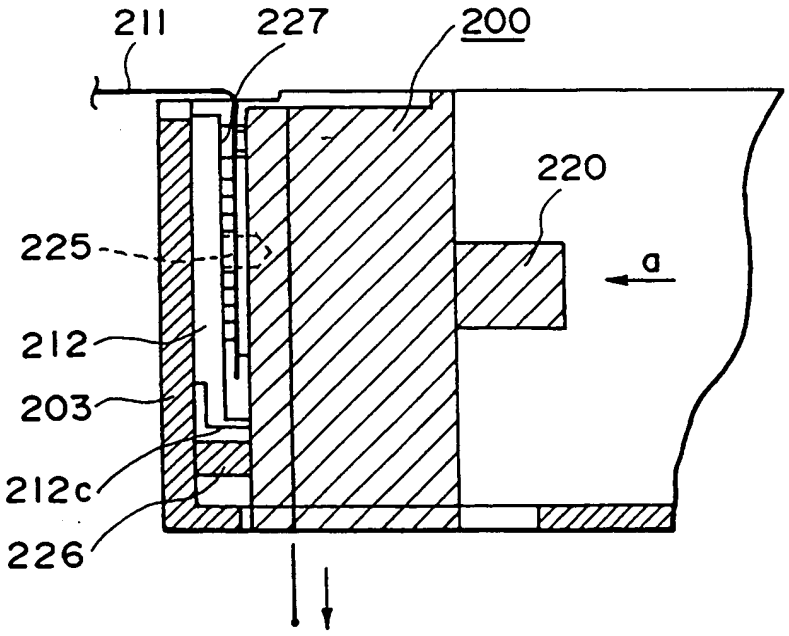
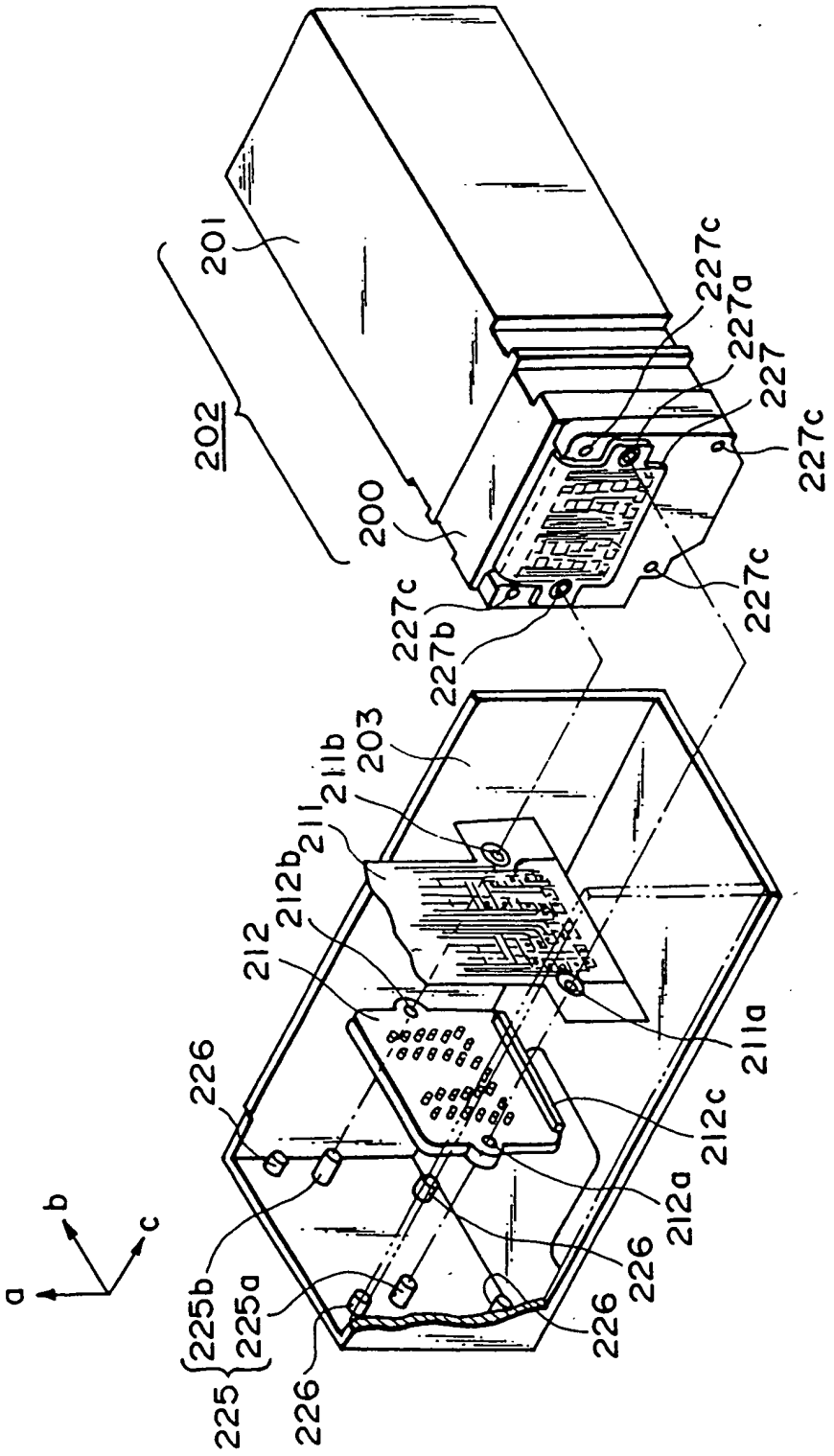

211
227
200
220
225
a
212
203
212c
226

FIG. 3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202
200
227c
227a
227
227c
227c
227b
227c
203
211b
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212b
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226
225b
225a
225
a
b
c

FIG. 4

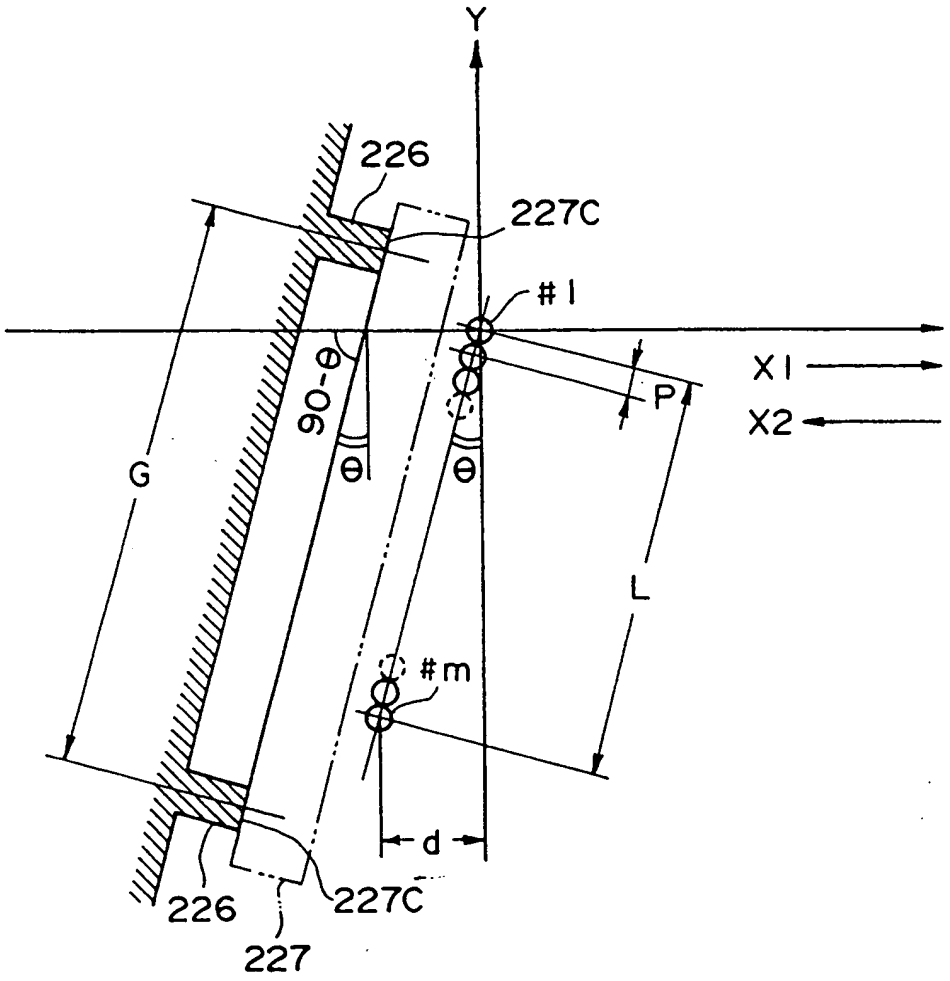


FIG. 5

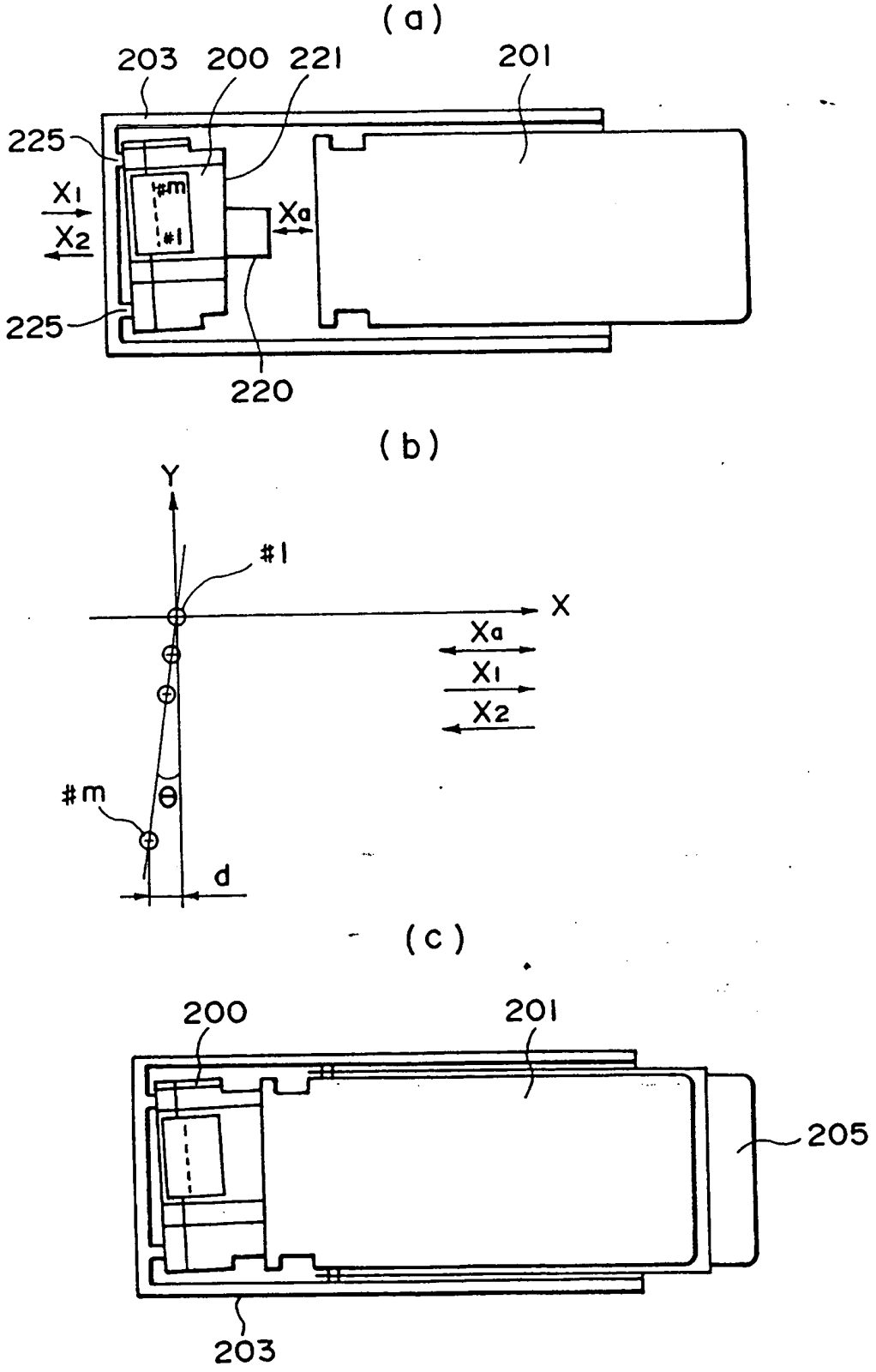
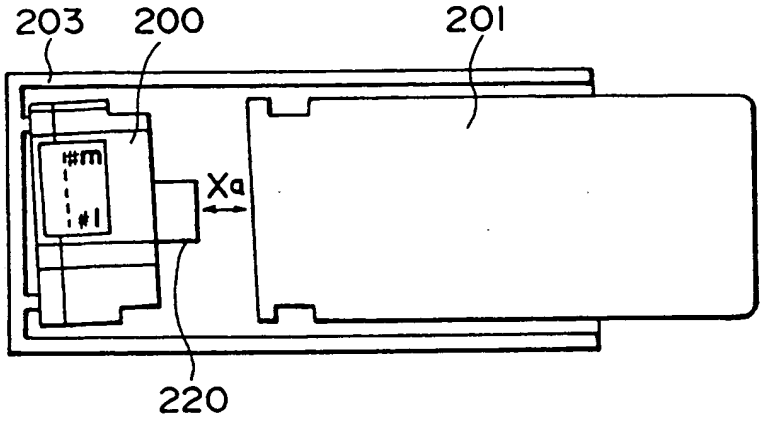

(a)
203
200
221
201
225
X1
X2
#m
#1
Xa
225
220
(b)
Y
#1
X
Xa
X1
X2
#m
θ
d
(c)
200
201
205
203

FIG. 6

(a)



(b)

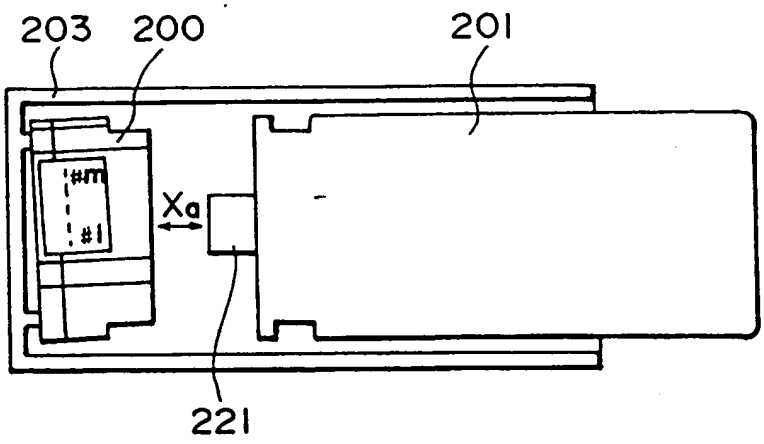


FIG. 7

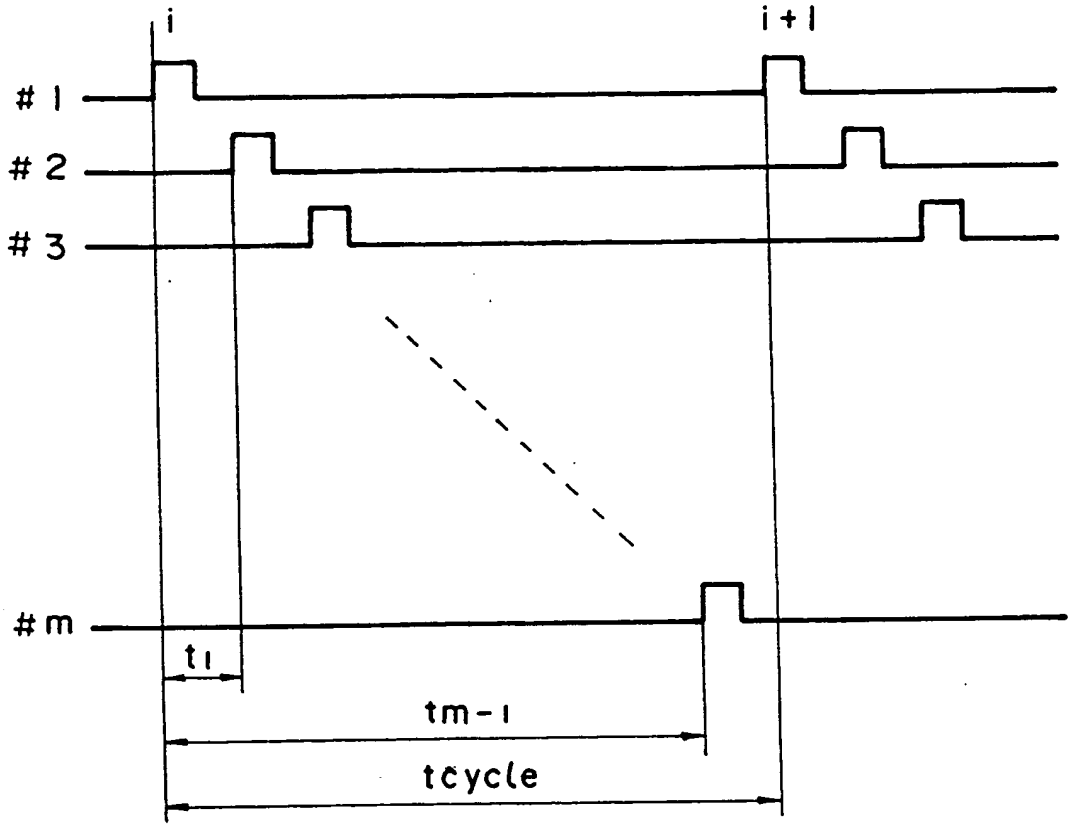


FIG. 8

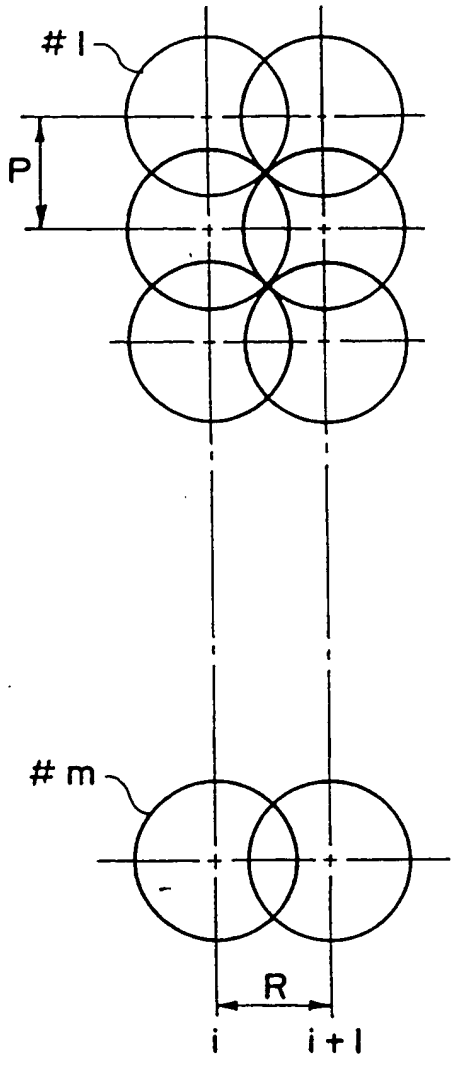
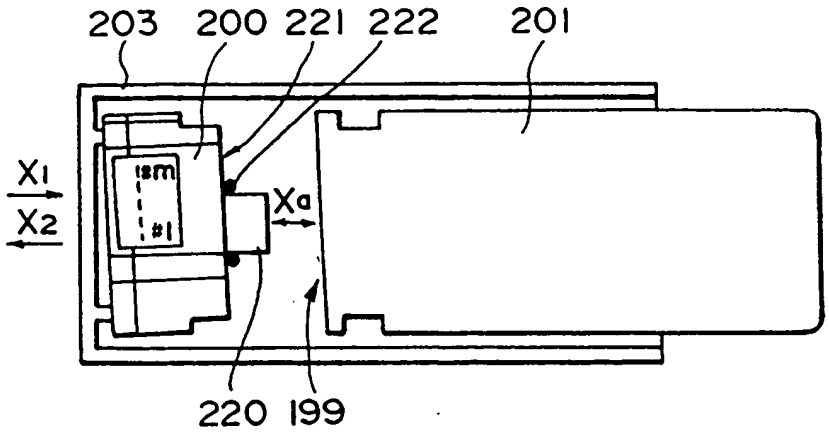


FIG. 9

(a)



(b)

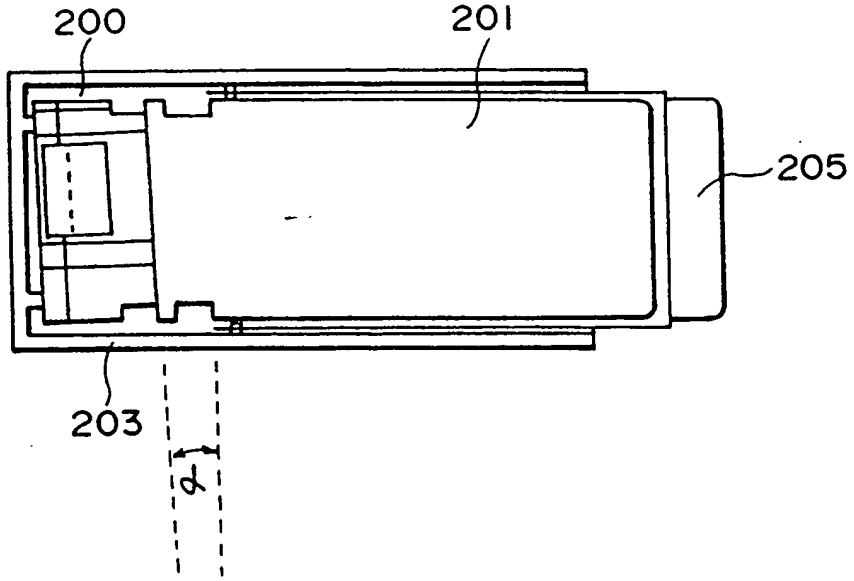
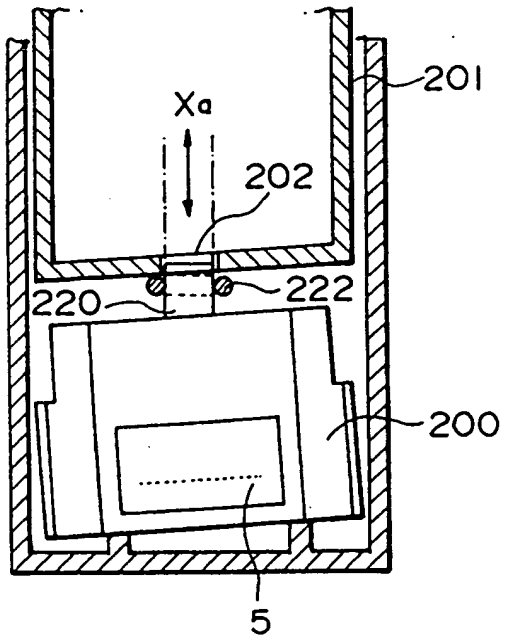


FIG. 10

(a)



(b)

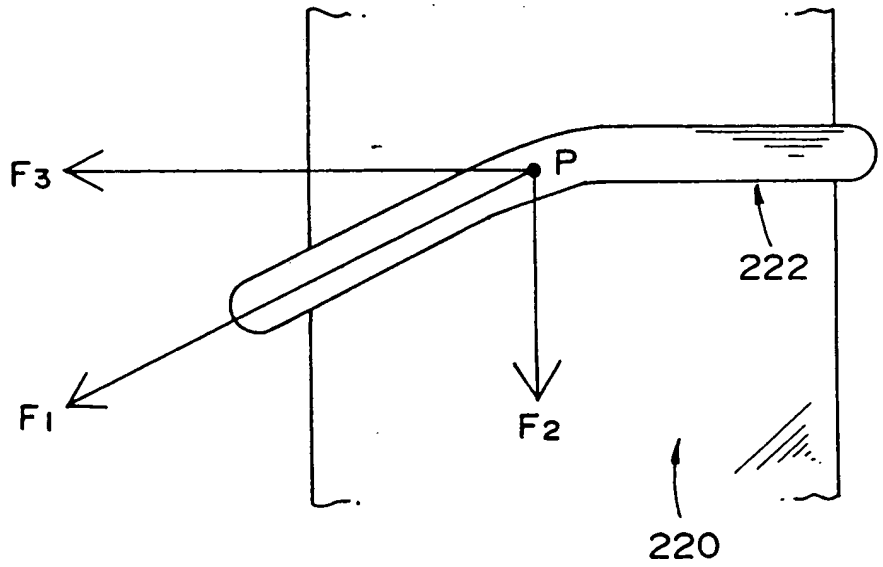


FIG. 11

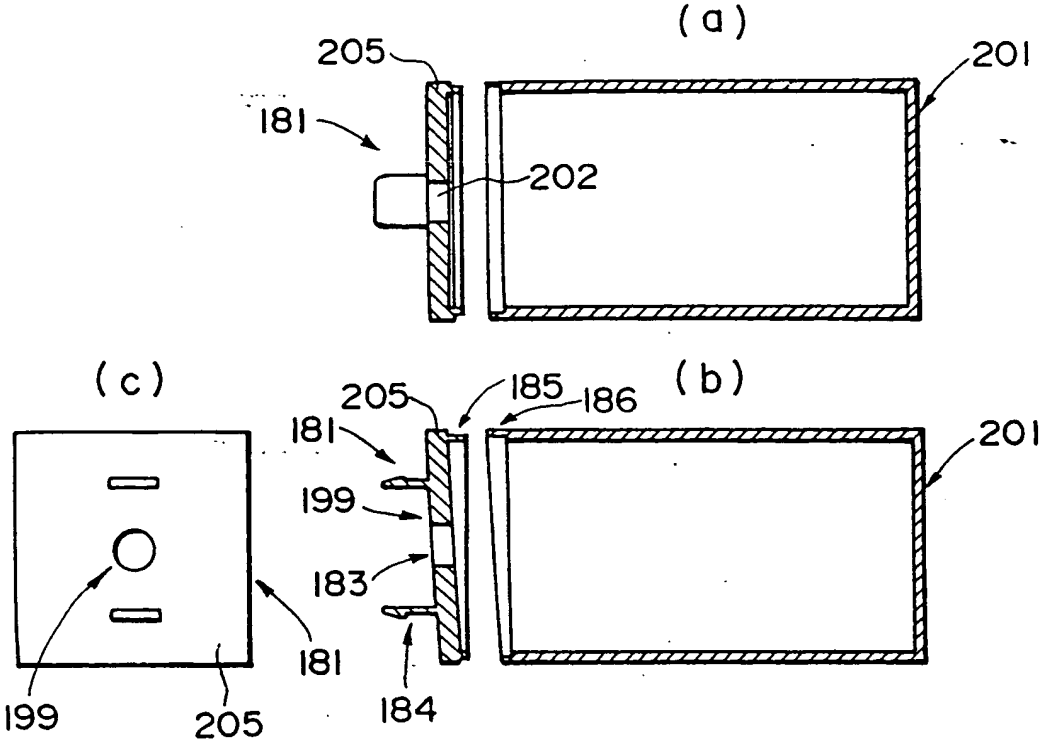
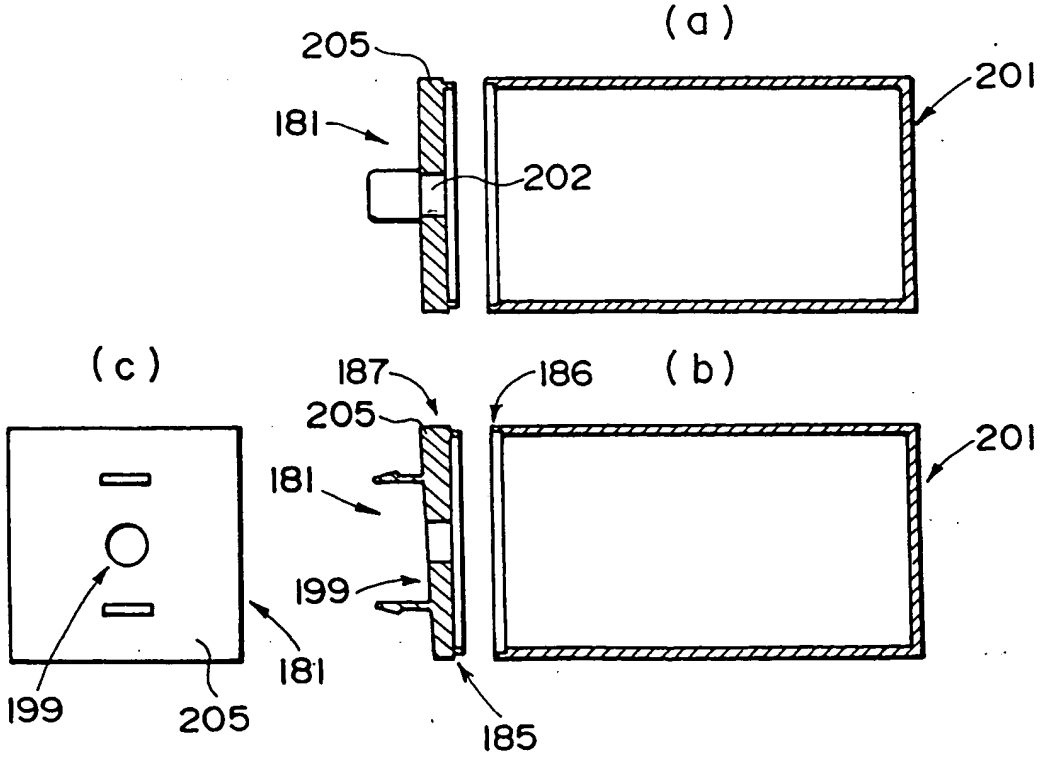

(a)
205
201
181
202
(c)
(b)
205
185
186
181
201
199
183
181
199
205
184

FIG. 12


(a)
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(c)
(b)
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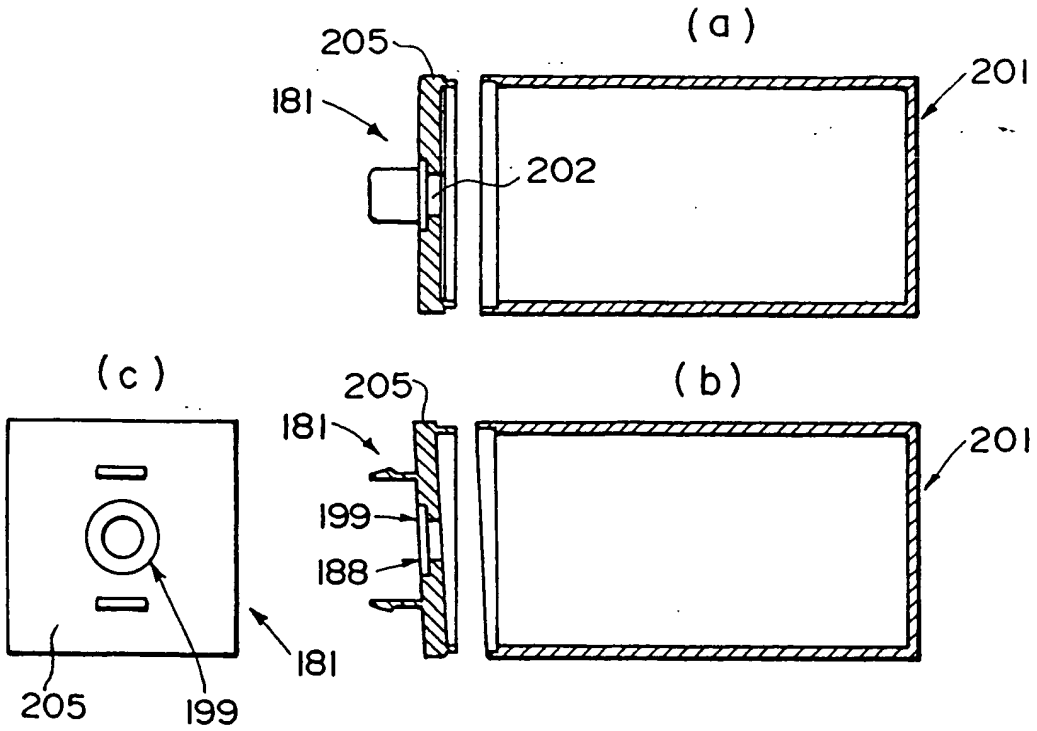
185

FIG. 13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(c)
(b)
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199
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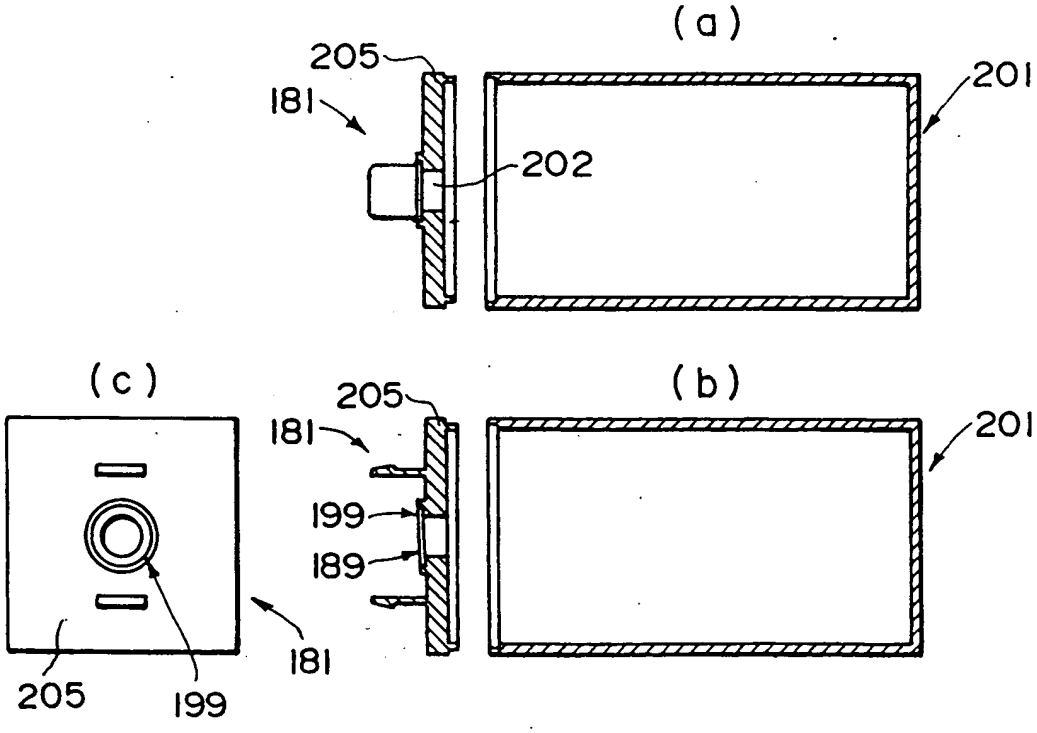
FIG. 14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(c)
(b)
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199

FIG. 15

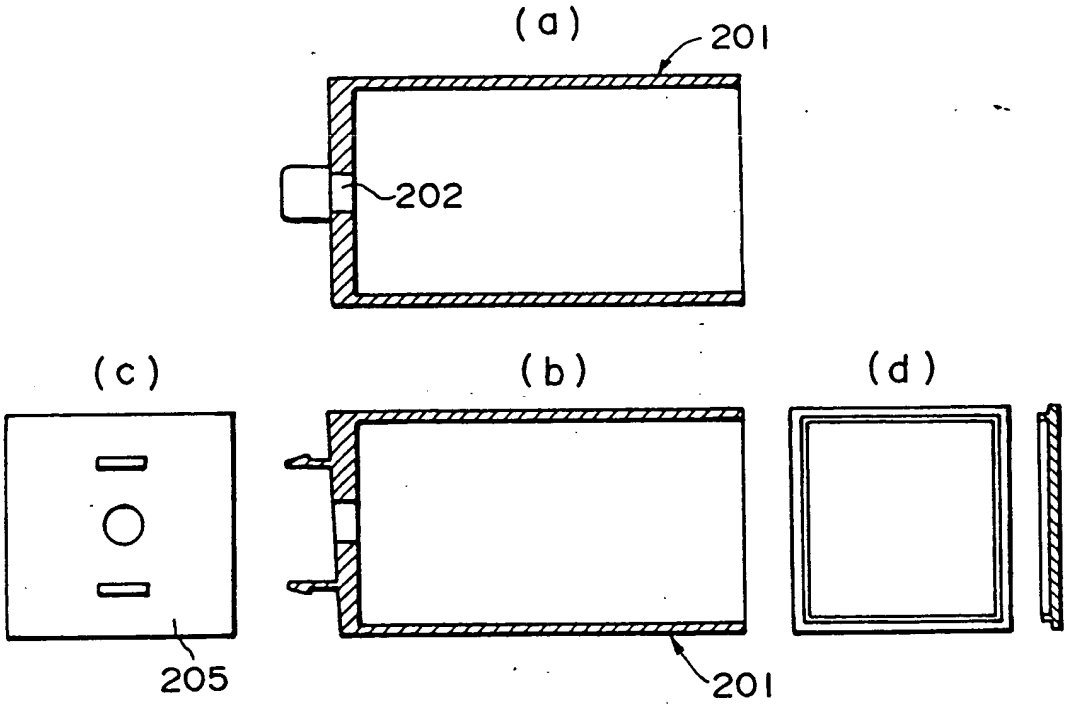

FIG. 16

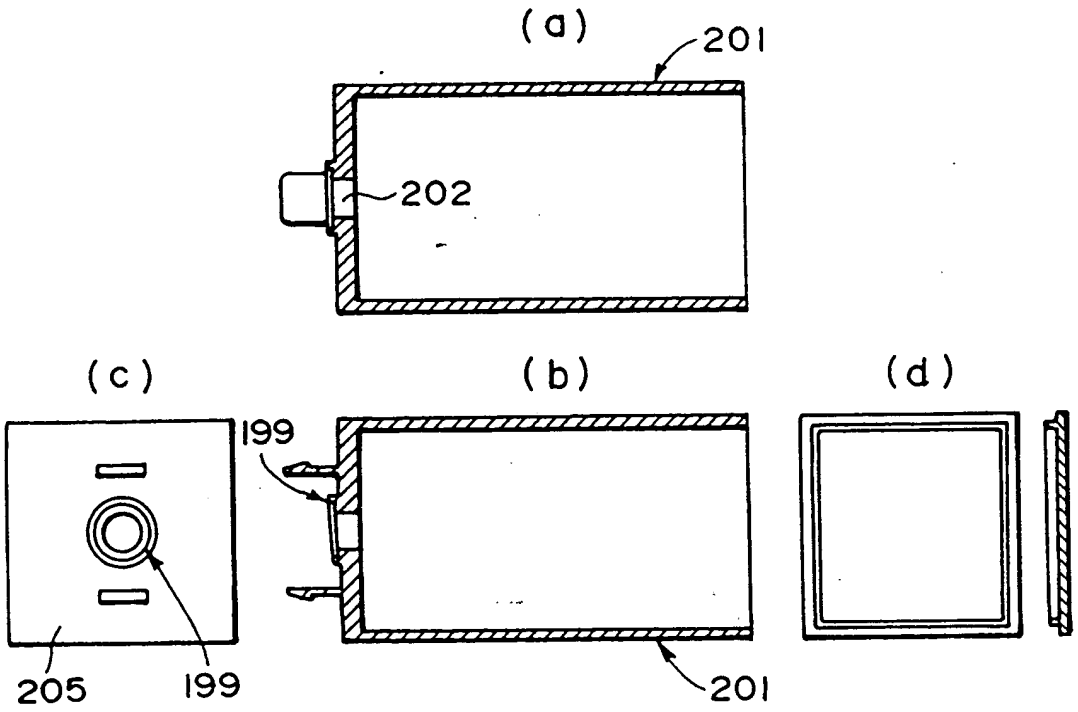

FIG. 17

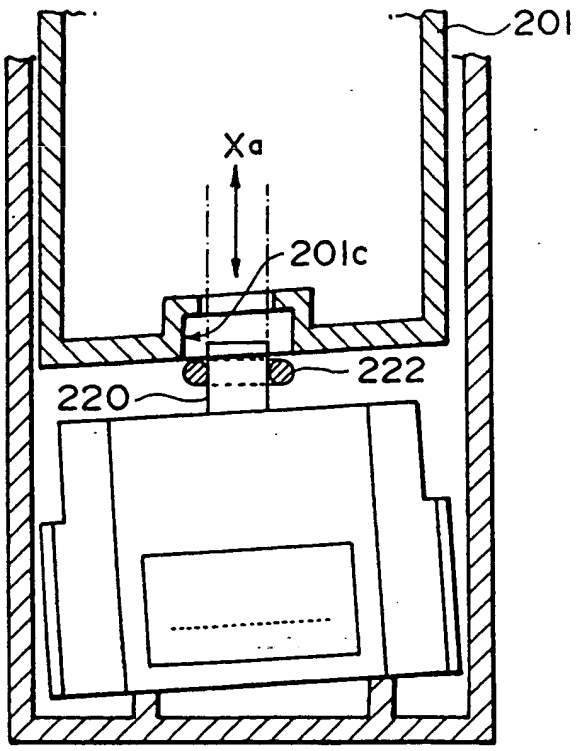

FIG. 18

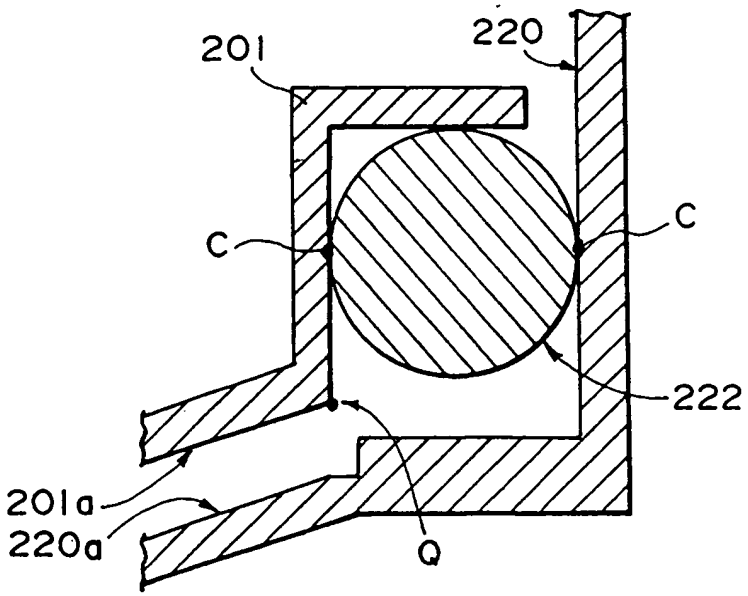

FIG. 19

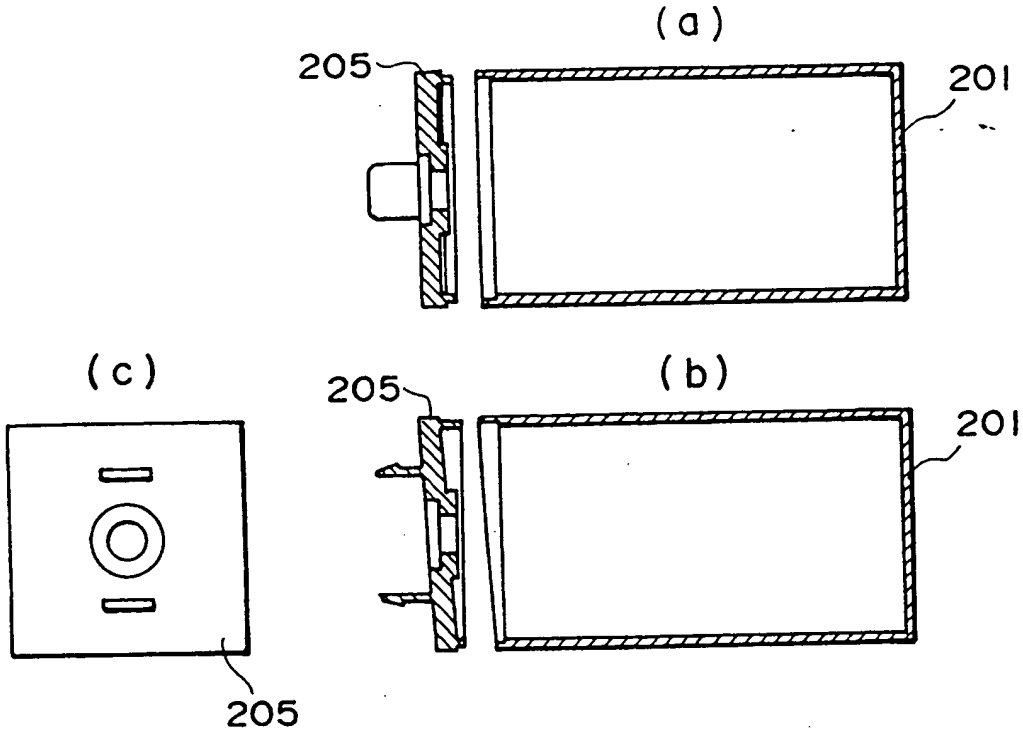

FIG. 20

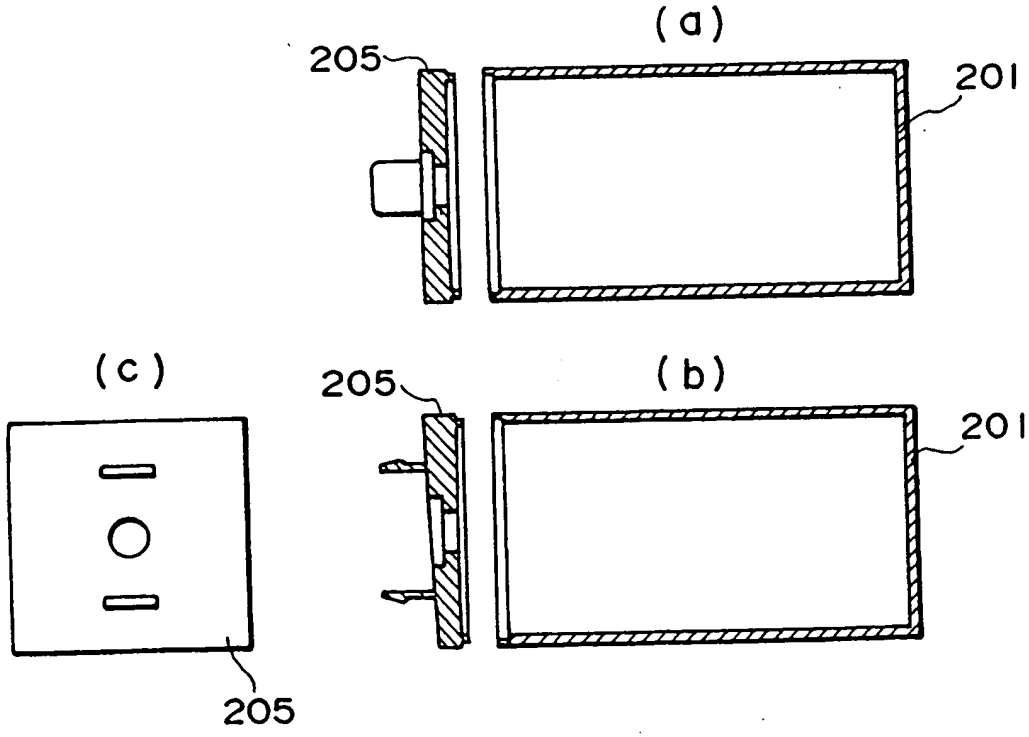

FIG. 21

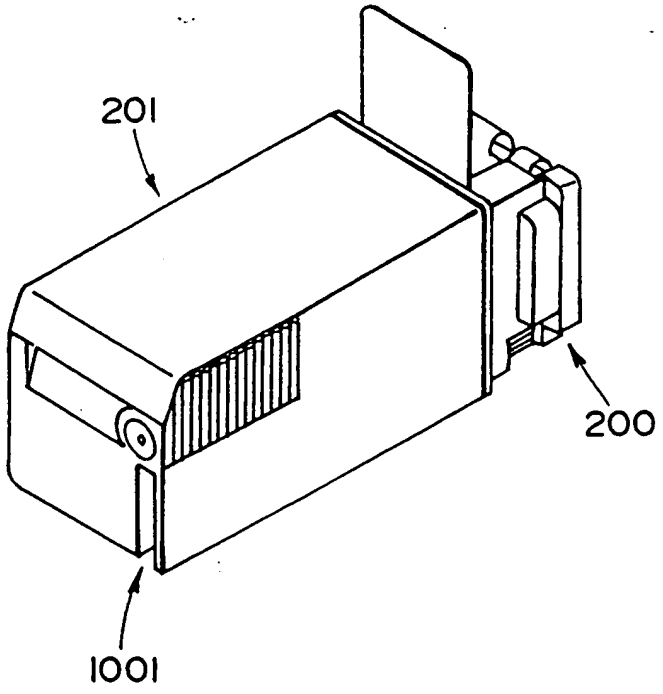

FIG. 22

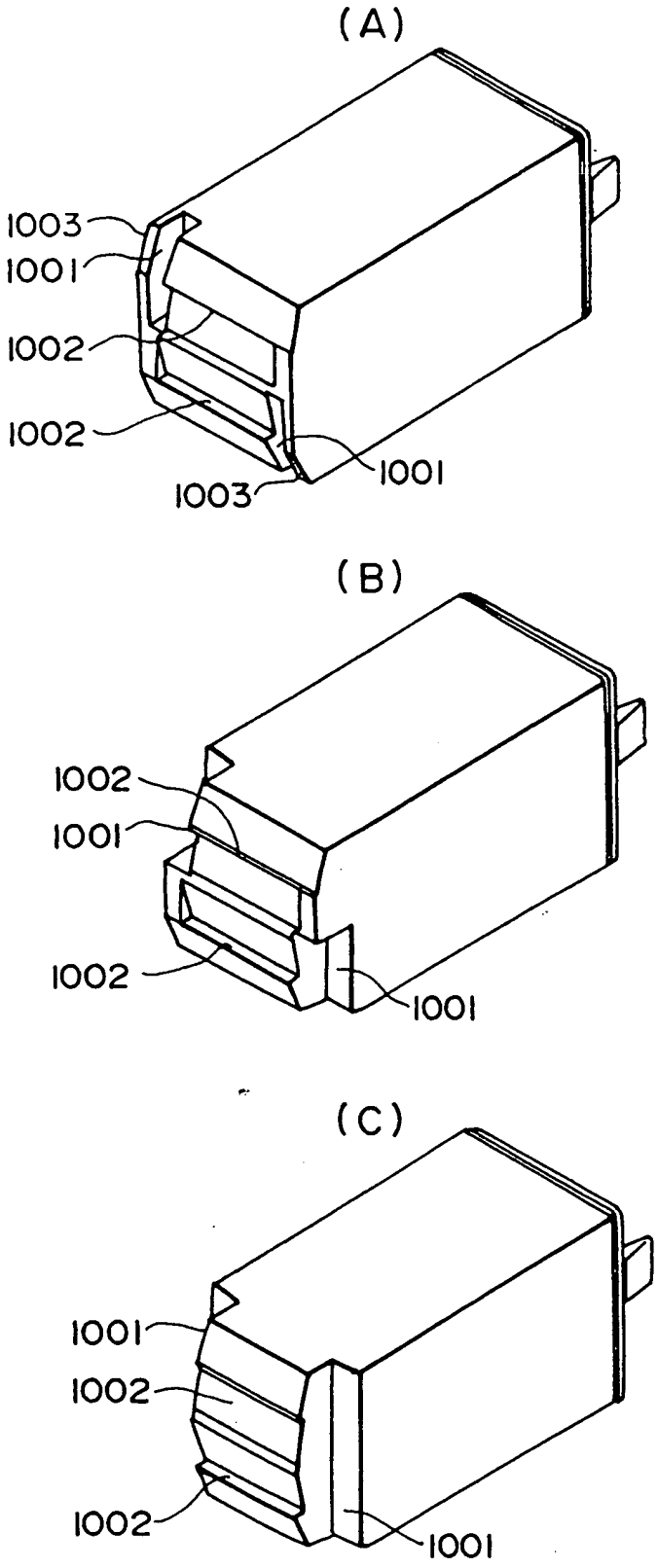
(A)
1003
1001
1002
1002
1003
1001
(B)
1002
1001
1002
1001
(C)
1001
1002
1002
1001

FIG. 23

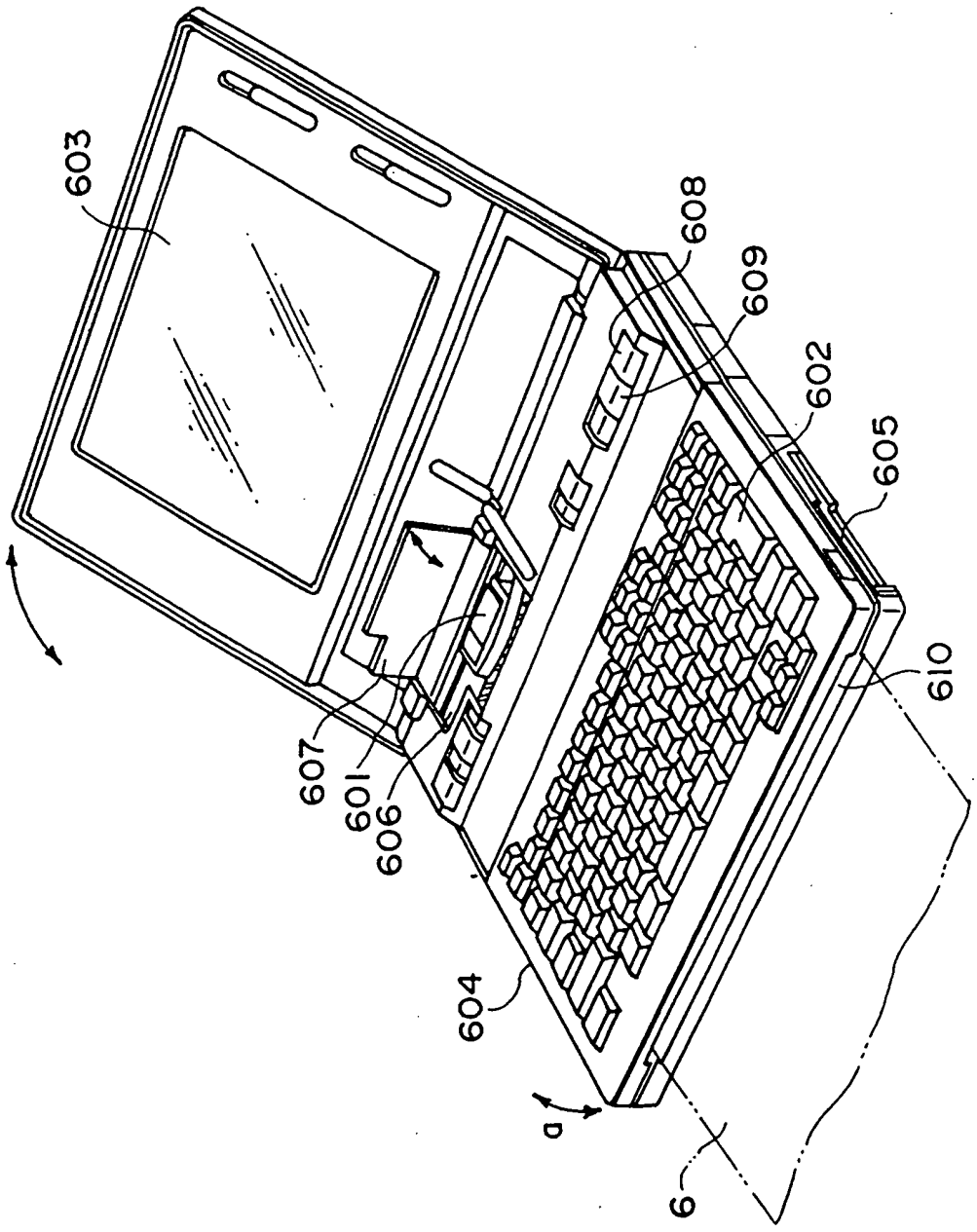

FIG. 24

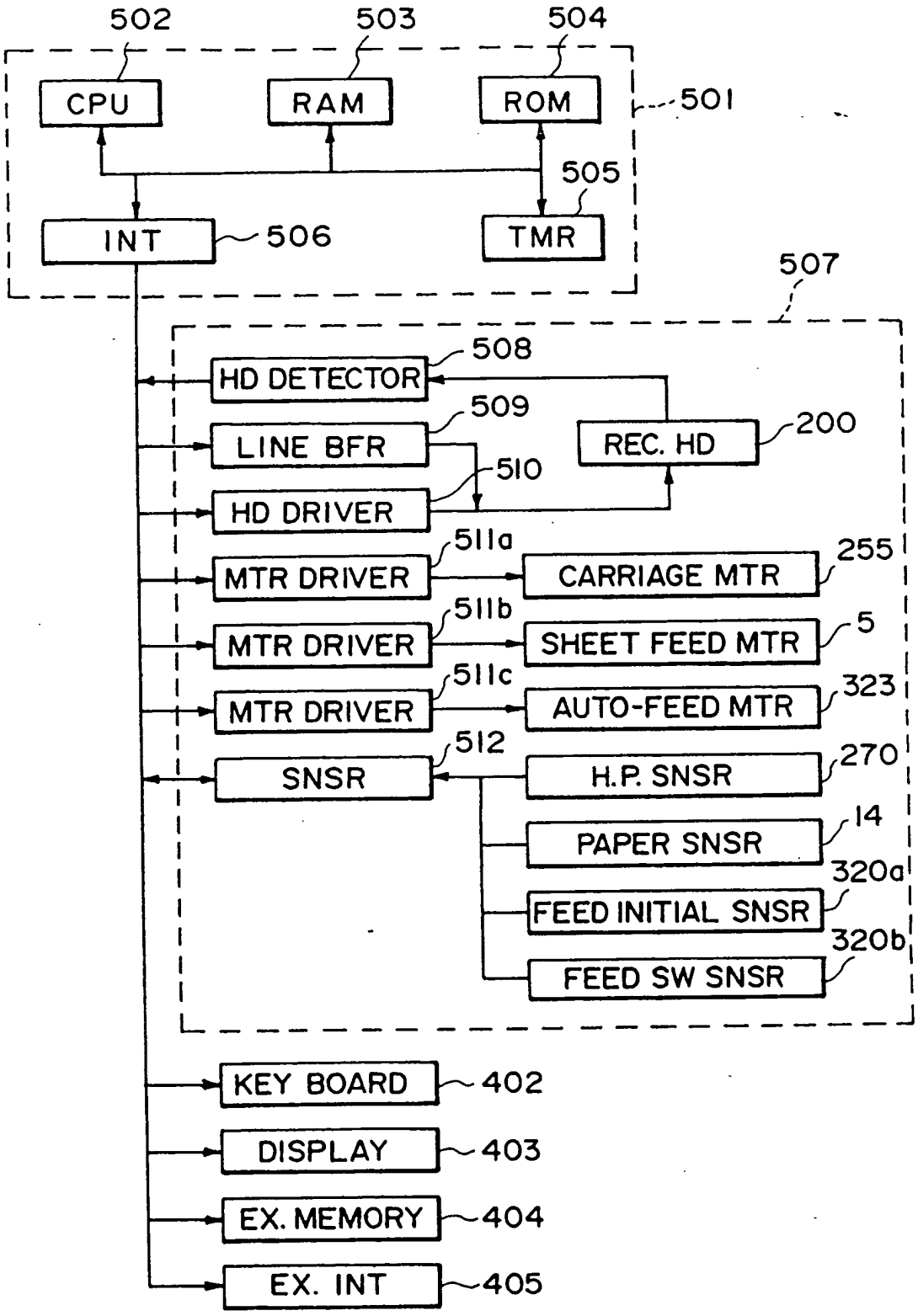
502
503
504
CPU
RAM
ROM
501
505
INT
506
TMR
507
508
HD DETECTOR
509
LINE BFR
200
REC. HD
510
HD DRIVER
511a
MTR DRIVER
CARRIAGE MTR
255
511b
MTR DRIVER
SHEET FEED MTR
5
511c
MTR DRIVER
AUTO-FEED MTR
323
512
SNSR
H.P. SNSR
270
PAPER SNSR
14
320a
FEED INITIAL SNSR
320b
FEED SW SNSR
KEY BOARD
402
DISPLAY
403
EX. MEMORY
404
EX. INT
405

FIG. 25

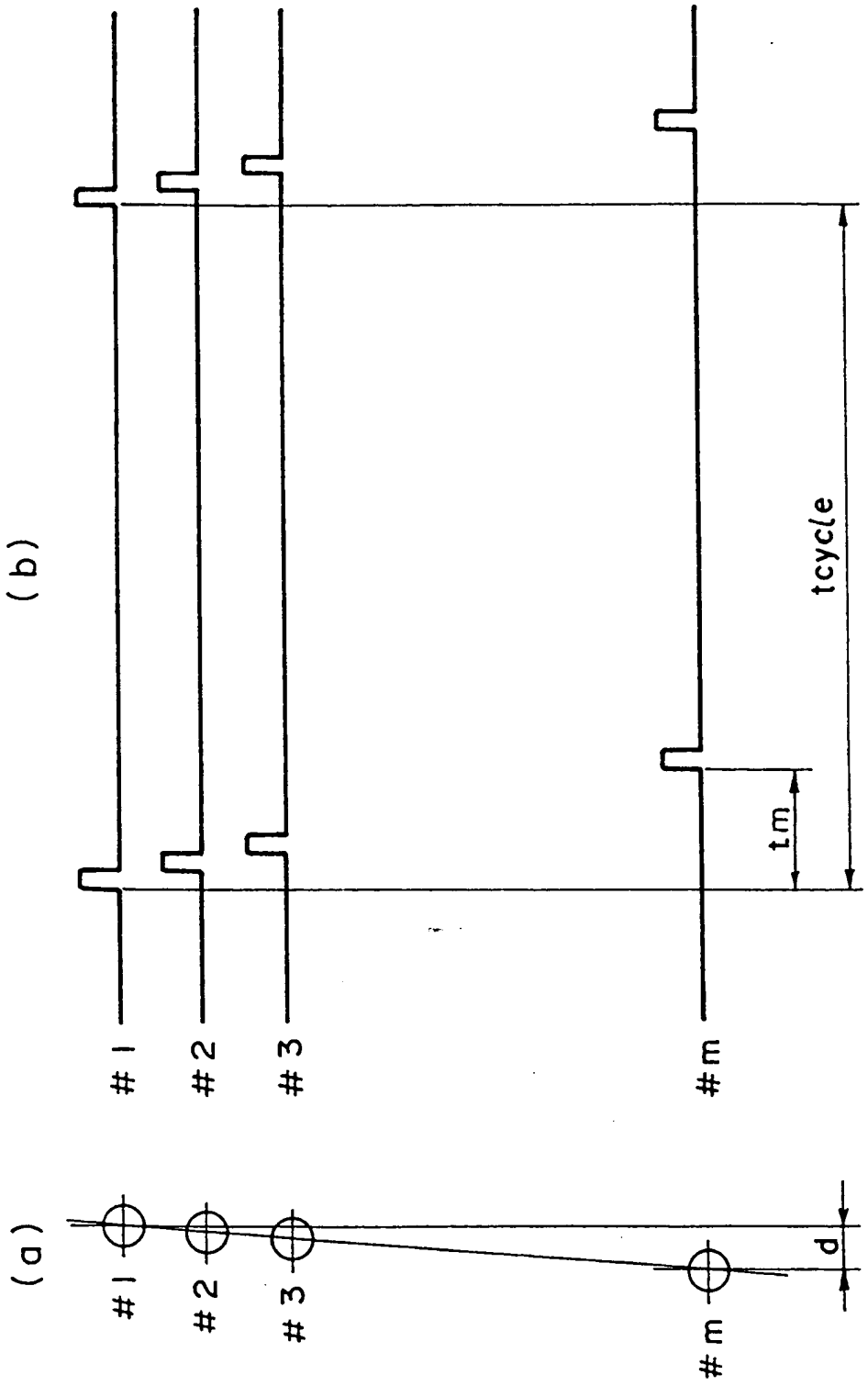

FIG. 26

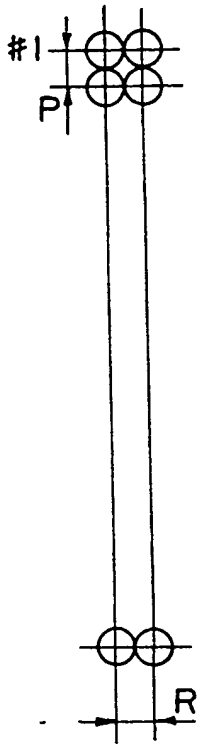

FIG. 27

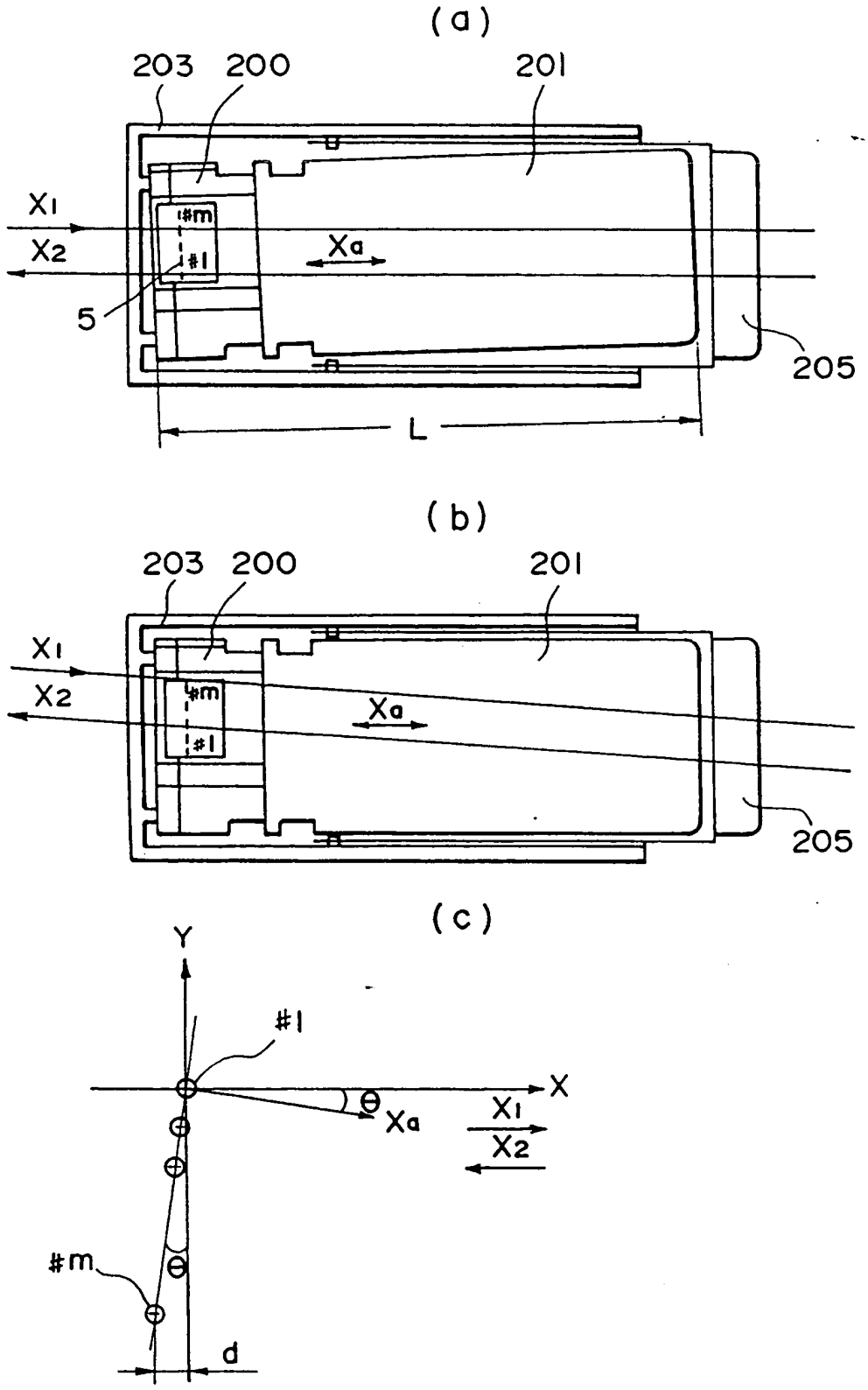
(a)
203
200
201
X1
X2
#m
#1
Xa
5
205
L
(b)
203
200
201
X1
X2
#m
#1
Xa
205
(c)
Y
#1
X
θ
Xa
X1
X2
#m
θ
d

FIG. 28

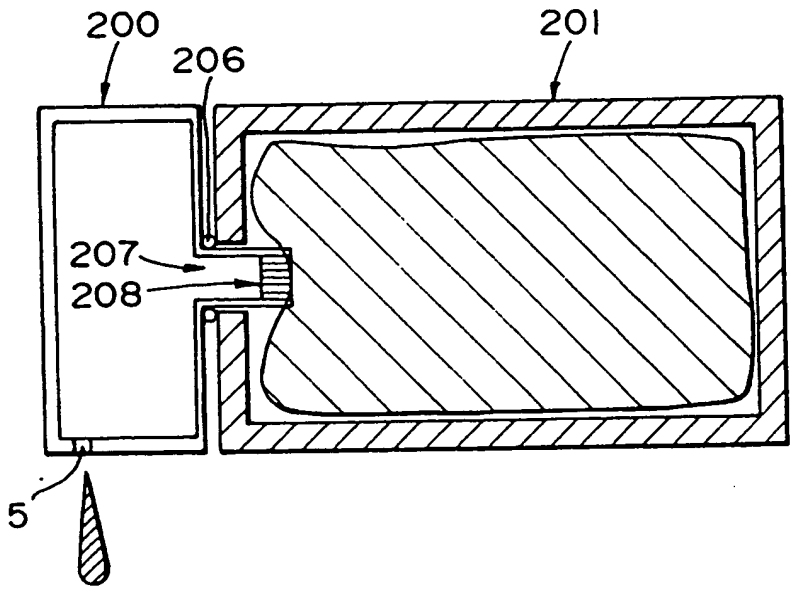

FIG. 29

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European Patent Office
Office européen des brevets

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(54) Ink jet cartridge, ink jet apparatus and ink container

(57) An ink container (201) connectable with an ink inlet portion of an ink jet head (200) having a plurality of ink ejection outlets, comprising an improvement in which a surface of the ink container (201) to be connected with the ink jet head (200) is inclined from a plane perpendicular to a detection in which the ink container (201) is connected with the ink supply portion.

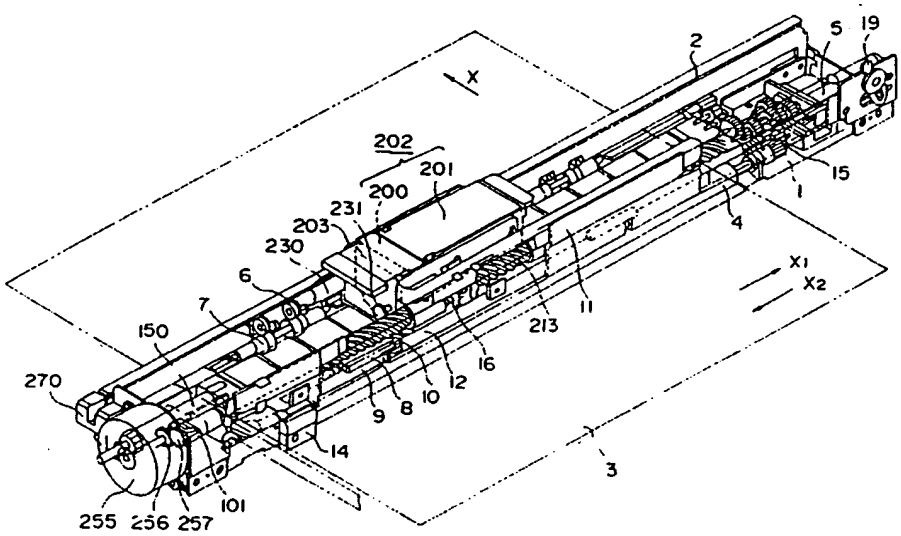

FIG. 1

EP 0 607 928 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 10 0664

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	PATENT ABSTRACTS OF JAPAN vol. 10 no. 171 (M-489) ,17 June 1986 & JP-A-61 020752 (CANON) 29 January 1986, * abstract *	1	B41J2/175 B41J25/34
A	---	2,8,9	
X	PATENT ABSTRACTS OF JAPAN vol. 9 no. 60 (M-364) ,16 March 1985 & JP-A-59 194854 (CANON) 5 November 1984, * abstract *	1	
A	---	2,8,9	
A	EP-A-0 380 199 (SHIMADZU CORPORATION) ---		
A	EP-A-0 443 722 (CANON) ---		
X	US-A-4 791 439 (GUILES) * column 3, line 26 - column 5, line 51; figures 1-3 *	3,4,6	TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	---	5,7,10	B41J
A	PATENT ABSTRACTS OF JAPAN vol. 10 no. 55 (M-458) ,5 March 1986 & JP-A-60 204331 (CANON) 15 October 1985, * abstract *	3-7,10	
A	--- EP-A-0 059 256 (SIEMENS) ---		
A	US-A-4 760 408 (KANAYAMA) ---		
A	PATENT ABSTRACTS OF JAPAN vol. 6 no. 193 (M-160) ,2 October 1982 & JP-A-57 100081 (SEIKO) * abstract * -----		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 January 1996	Adam, E

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